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PIPE LINE INDUSTRY

NOVEMBER
1958

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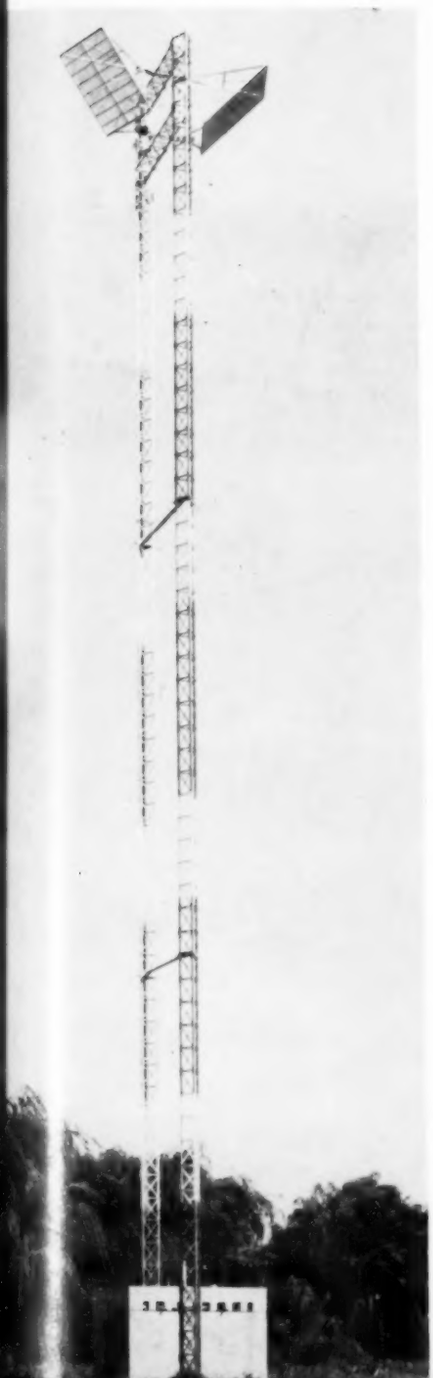

SPECIAL AUTOMATIC CONTROL REPORT

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CHEAPER RIVER CROSSING

Socony Pulls 8-Inch Thru Old 12-Inch 65

For a "Quick Look" at this issue, turn the page . . . . . .

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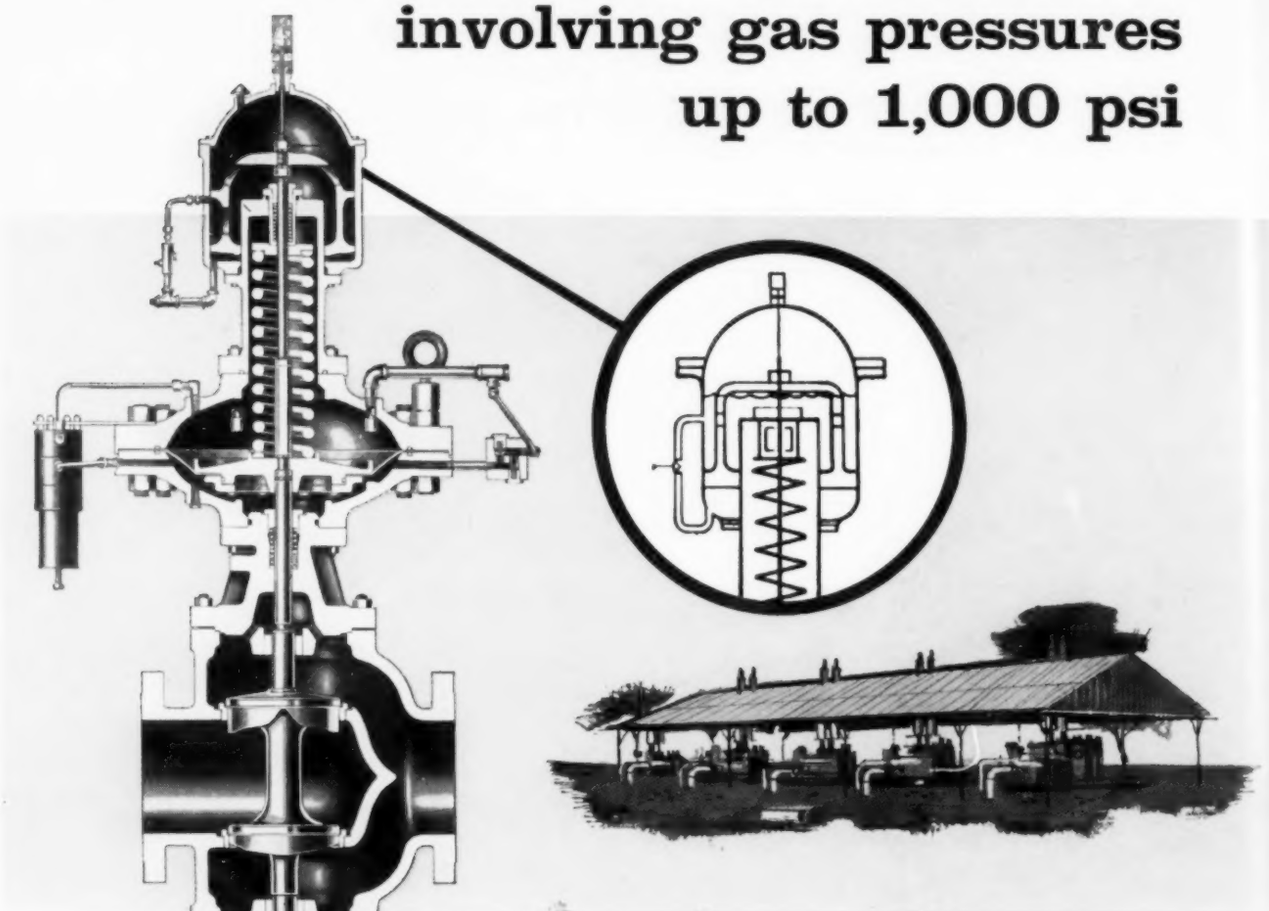

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When the gas industry needs a regulator that can withstand the dynamic forces of large flows and high velocities, it turns to the Fisher Type 885-1. Here's the ideal high pressure gas regulator for the difficult reducing jobs on transmission lines and large town border stations. The inner valve is dampened and cushioned by a special oil dash pot. The inner valve jumping sometimes encountered in high capacity, high pressure systems is eliminated. For further information about the Fisher Type 885-1, send for Bulletin P880-A.

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PIPE LINE INDUSTRY

CONTENTS and Quick Look

November, 1958 gpc Vol. 9, No. 5

To help you put first things first, scan these time-saving digests, checking ☑ those you want to read first.

What We Need for Better Batch Interface Detection

☐ Representatives of four pipe line companies discuss their experience with various types of batch interface detection instruments, both operational and experimental. While the most interest is shown by products pipe line companies, with the increase in automatic custody transfer, crude oil pipe lines are becoming more concerned. General consensus of engineers today is that present systems are not reliable enough for unattended operation. Experimental models under consideration show promise of overcoming this deficiency.

By C. W. Blackburn, R. R. Hancox, C. V. Baxter and W. W. Holt, Jr. ..... Page 36

New German Magnetic Girdle Makes Automatic Field Welds Practical

☐ Three year's experience with this method during construction of over 20 miles of 8 and 12-inch utility lines in West Germany shows that it offers good prospects for faster, uniformly high quality welds. Rod is held in position by linkage of electromagnetic elements. Weld progresses downhill as magnetic field forces molten metal flow into bevel and out to pipe wall. Here is a photo report of shop demonstration in Houston for U. S. contractors and pipe line engineers.

By Melvin A. Judah ..... Page 42

Arapahoe LACT Unit Sets Record Transfer

☐ Efficient operation is featured in largest LACT installation. Transferring production of Pure Oil Company to the Arapahoe Pipe line in the Adena field, Colorado, this unit has completed six months of operation. Elimination of storage assures smooth flow of production with a minimum of loss due to evaporation. During the first three months of operation, 743,058 barrels were received through the unit. Maximum design capacity is 36,000 bpd which is over 20 percent of total LACT capacity now in operation.

By John C. Watts ..... Page 46

United Gas Fits Automation to Oldtimers

☐ To gain some of the advantages of automatic control on those compressor stations with up to 30 years of service, United Gas Pipe Line Company installed 35 simply designed, shop fabricated supervisory panel boards. Circuitry is kept simple, using standard relays, sockets and lamps. Safety with low power rating and wiring scheme; plus interchangeability of parts or entire panels makes for ease in troubleshooting.

By Clyde Epps and C. L. Walters ..... Page 50

Today's Trends in the Use of the Tools of Automation

☐ Here is a detailed report of a leading manufacturer's survey of the pipe line industry which shows the design approach of most leading crude oil and products engineers and operating management. In the survey, 48 companies were contacted. Answers to a comprehensive questionnaire point out the engineering thinking in automatic control now being applied on 112,000 miles of lines.

By E. B. Turner ..... Page 52

Unattended "Stop-and-Go" Reciprocating Station

☐ Texas Eastern is now controlling three reciprocating compressor units at its Linden, N. J., station from a control console at Lambertville, 50 miles away. In this first remote control application on a large multiple unit reciprocating station there were many problems that had to be overcome in design and initial operations. These were complicated by operating demands on the station; it is normally in service only one or two months a year to boost gas on periodic daily or hourly needs of New York area consumers.

By F. Vinton Long, Richard J. Mathias and William L. Fouche ..... Page 58

Socony Pulls 8-Inch Through Damaged 12-Inch Under Delaware River

☐ Repair of an underwater pipe line damaged by a ship's anchor was solved in an unusual way by Socony Mobil Oil Company in a recent river crossing job near Philadelphia. The ruptured 12-inch serves as a 6,300-foot "casing" for the 8-inch standby products line. Crews installed a repair coupling under the river, threaded a pulling cable through the old line with air pressure behind a pig and pulled the 8-inch through, using a fuel oil fill in the annulus to lubricate pipe walls and reduce drag.

By H. T. Brundage ..... Page 65

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PIPE LINE INDUSTRY published every month. Entered as second class mail matter July 9, 1954, at the post office at Houston, Texas, under the act of March 3, 1879.

Contrary to Fact

Two events that occurred in widely separated sections of the country during Oil Progress Week point up very clearly a continuing need for giving the public a better understanding of pipe line industry operations.

1. On October 14, President Robert W. Otto of the American Gas Association told delegates attending the 40th annual convention in Atlantic City that the "probability of public injury or property damage from the operation of natural gas transmission pipe lines is so negligible as to be almost non-existent." He cited the record tabulated by the association's Transmission subcommittee, that during the 16-year period from 1940 to 1955 only four members of the public were killed as a result of natural gas pipe line failures in actual operations. Two of these fatalities resulted from one failure.

Considering that U.S. gas transmission companies achieved this record while operating more than 152,500 miles of pipe line, 24 hours a day, under extremes of weather and other physical conditions, it is an amazing record.

2. On the same day, the City Council of Houston voted to prevent a major oil company from laying a natural gas pipe line through it's Lake Houston municipal water supply because the council considered it potentially hazardous to sportsmen, marine life and the city's water source.

Expert testimony given before the Council by a consulting engineer and by a former utilities director included the comments . . . "you can reasonably expect a pipe line in the lake to leak . . . there is always the distinct possibility that the line may break . . . we all know that pipe lines break at times and we don't want it to contaminate the water . . . that much pressure in case the line breaks, could whip the pipe like a bullwhip . . ."

Additional strong support against relocating the line in the lake was given by a local sporting club whose members (or officers) probably knew virtually nothing about pipe lines or their operation. Influence of this kind of testimony led to a council vote against the return of the pipe line under the lake water.

Refusal to allow the gas line to be constructed under the lake is not as alarming as are the comments voiced by the witnesses and some councilmen in arriving at the decision to prohibit Magnolia Petroleum Company from relocating the line in the lake.

Originally the line had been located at a point in the watershed where the city decided to build a dam; the city therefore required the oil company to move the line a few years ago. It was relaid below the dam spillway. In the past few months erosion caused Magnolia to request permission to shift the line to a location above the dam in the main body of the lake.

Just How Safe Are Gas Pipe Lines? As the AGA record shows, many miles of these lines have been in operation for years with virtually a perfect record. Hundreds of miles of lines are operating under busy waterways and lakes without causing any public hazards.

Certainly, even one death from a preventable pipe line failure is too many. But recognizing the service that the gas transmission industry supplies to millions of consumers and industry, its service and safety record is an outstanding one. In reality, it is in sharp contrast to the misunderstanding of far too many government leaders . . . and the general public.

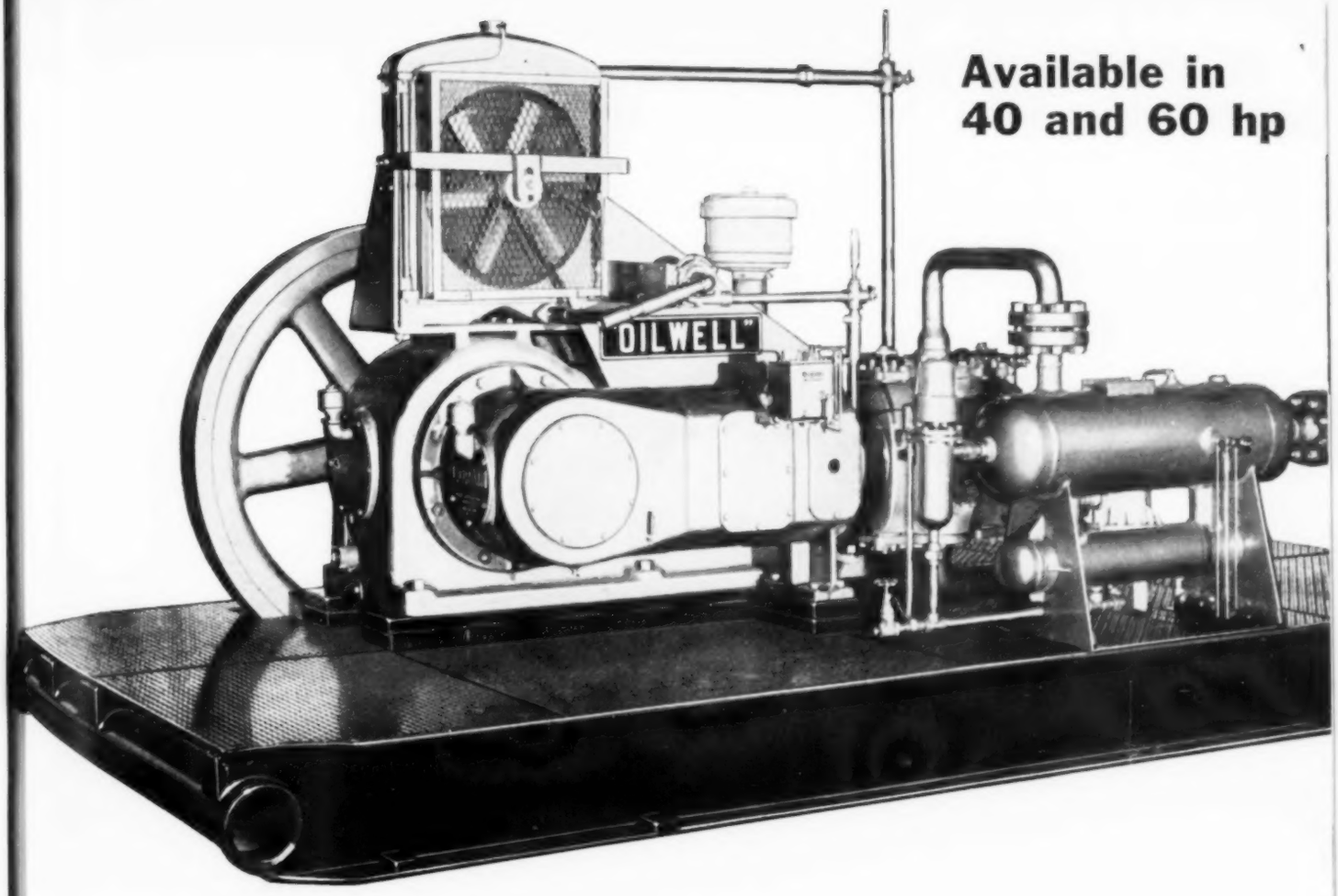
Who Can Supply the Facts? Only experienced and qualified gas pipe line engineers can be in a position to advise public officials and regulatory groups on the safety record of the gas transmission industry. They know how it has been achieved. If they don't do it, no one else will.

All thinking men realize that those officials who have the responsibility for safeguarding the public interest have a need for a clear understanding of the facts about the oil and gas industry.

It would be well for the industry to encourage its various engineering groups and the qualified voices within them to speak out for the facts when such cases are before local, state or federal authorities. If they don't, groups with little or no knowledge of the facts will continue to sway public officials in the making of unrealistic decisions.

One injustice to the industry may not seem too alarming to those of us who aren't hit but complete misunderstandings of the industry which lead to such decisions should be corrected before the next case comes up.

Truth is the whole made of many, many small parts. To keep the true facts before the American public and government officials takes 52 "Oil Progress Weeks" a year.



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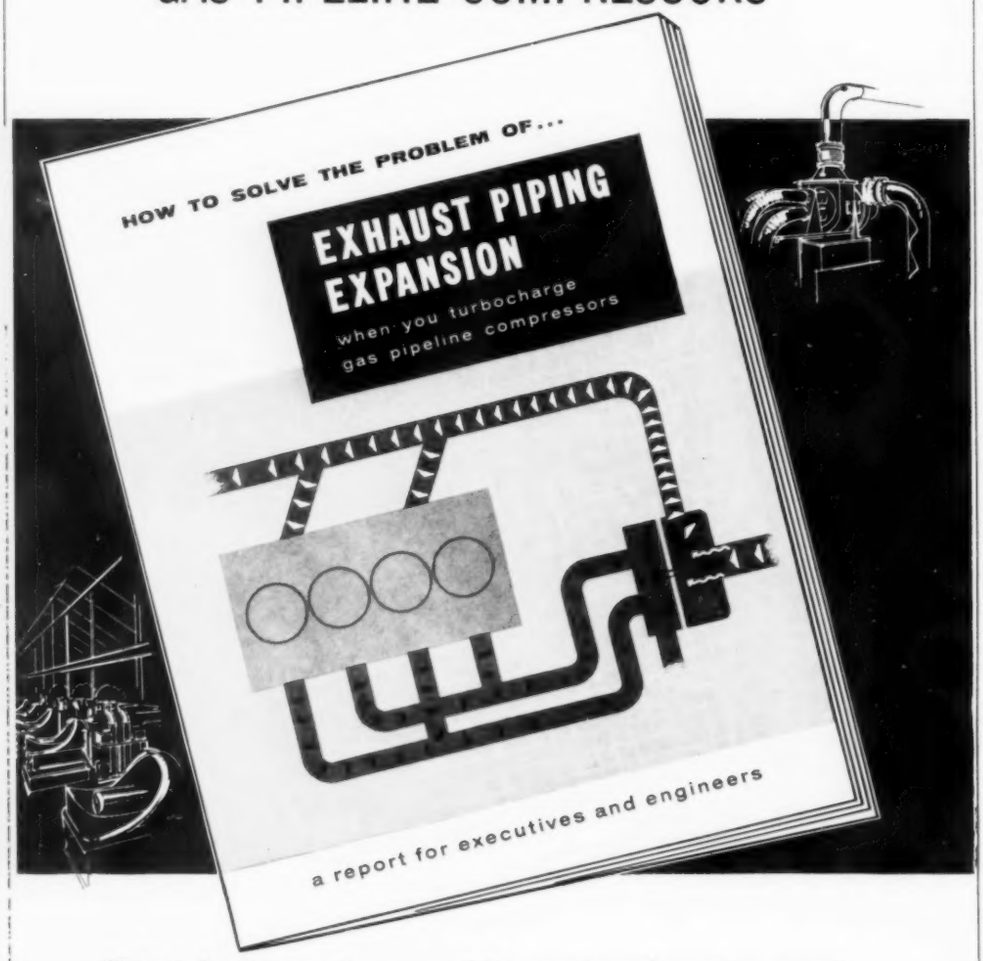
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PETROLEUM REFINER and THE REFINERY CATALOG for the oil, gas and petrochemical processing industry.

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Indexed by Engineering Index

CRADLING IN NEW YORK — Bechtel Corporation uses its MD7 for cradling operations on a steel gas line. The company has used Cat Pipelayers for a long time. They have enough reserve power to keep going under really heavy loads.

PIPELAYING IN CALIFORNIA — The MD7 lowers in a 16-inch steel gas line for Underground Construction Co. & Stolte Inc. "Cat-built Pipelayers are reliable and the 24-hour parts service we get is a big boon for us," says Project Engineer R. E. Hall.

DRILLING IN ARIZONA — Here Cape Construction Co. uses its MD7 for a drilling operation on a 24-inch crude oil line, running from Four Corners to Los Angeles. In rough going, pipe is being put in the ground at a rate of 2 miles a day. "We rely on Cat-built Pipelayers to get the job done," says Garland Mims, spread superintendent.

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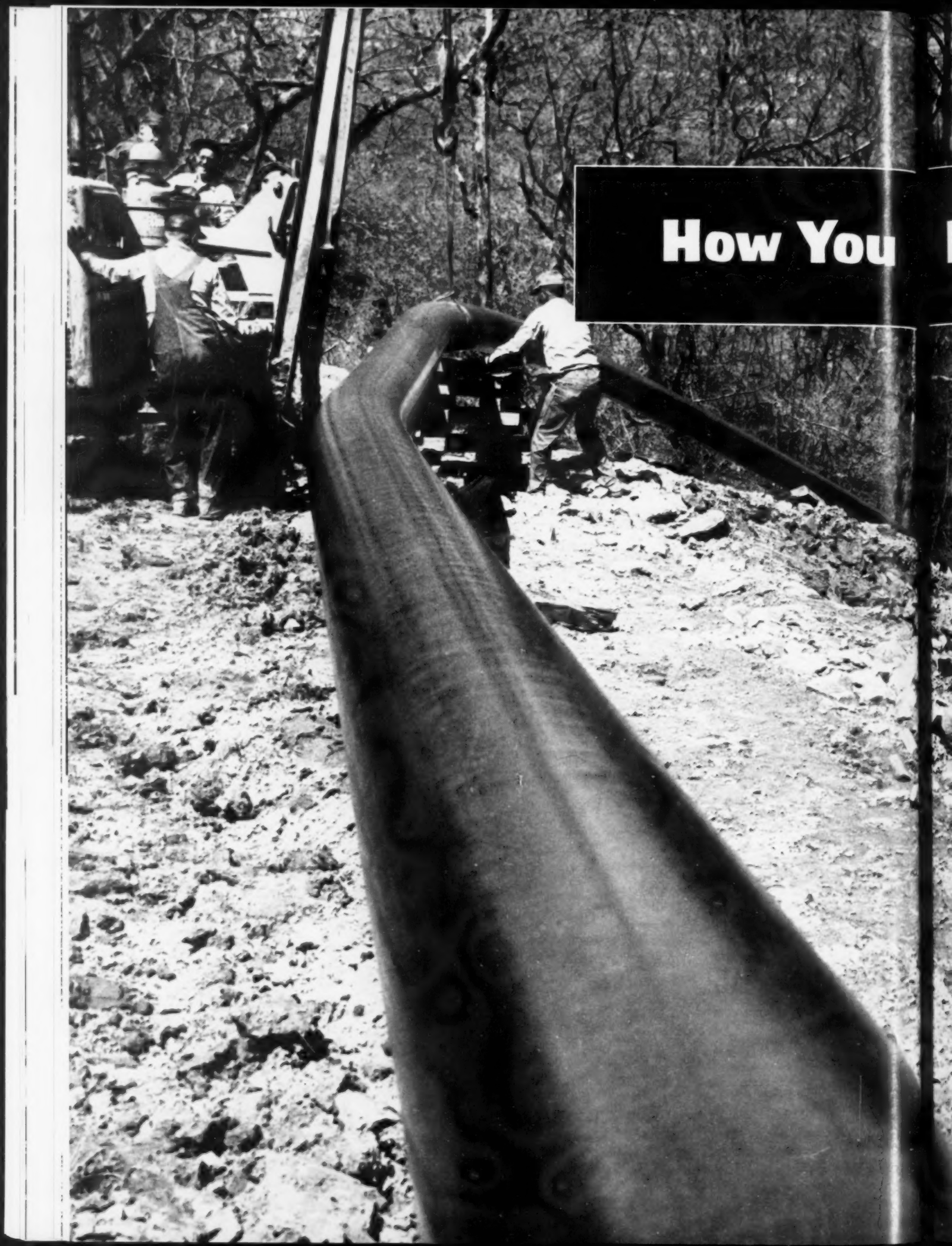
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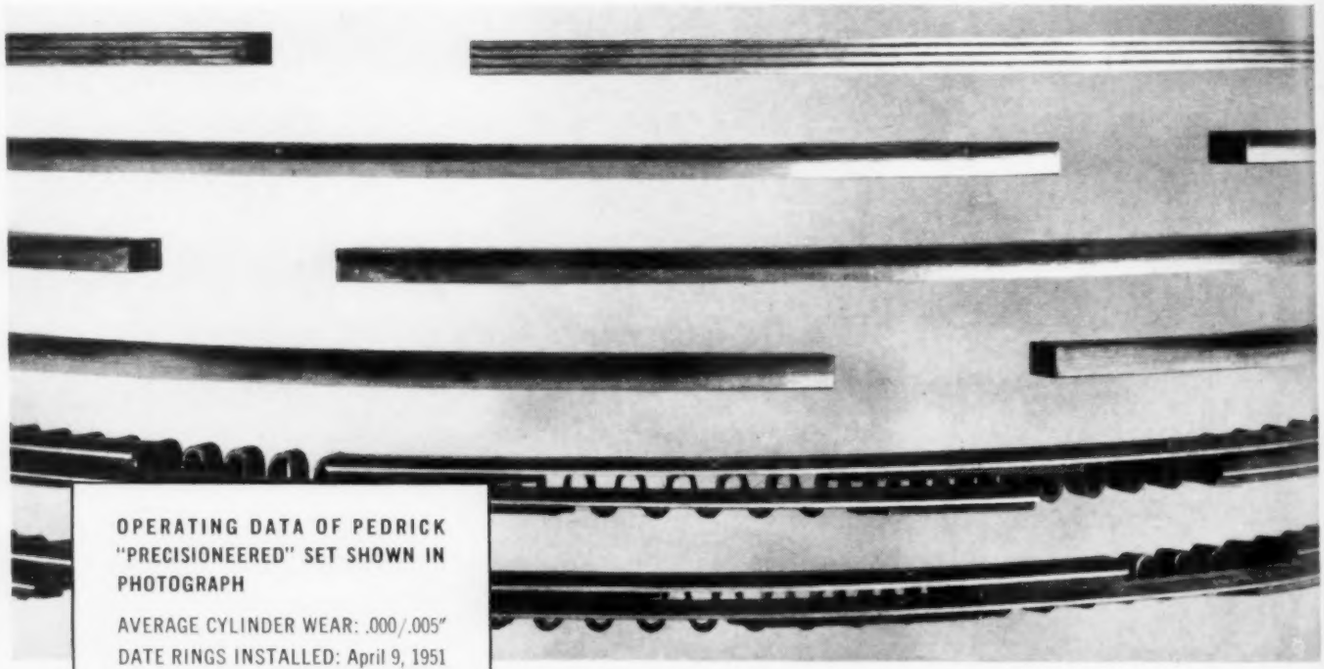

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MAXIMUM OVERLOAD: 10%
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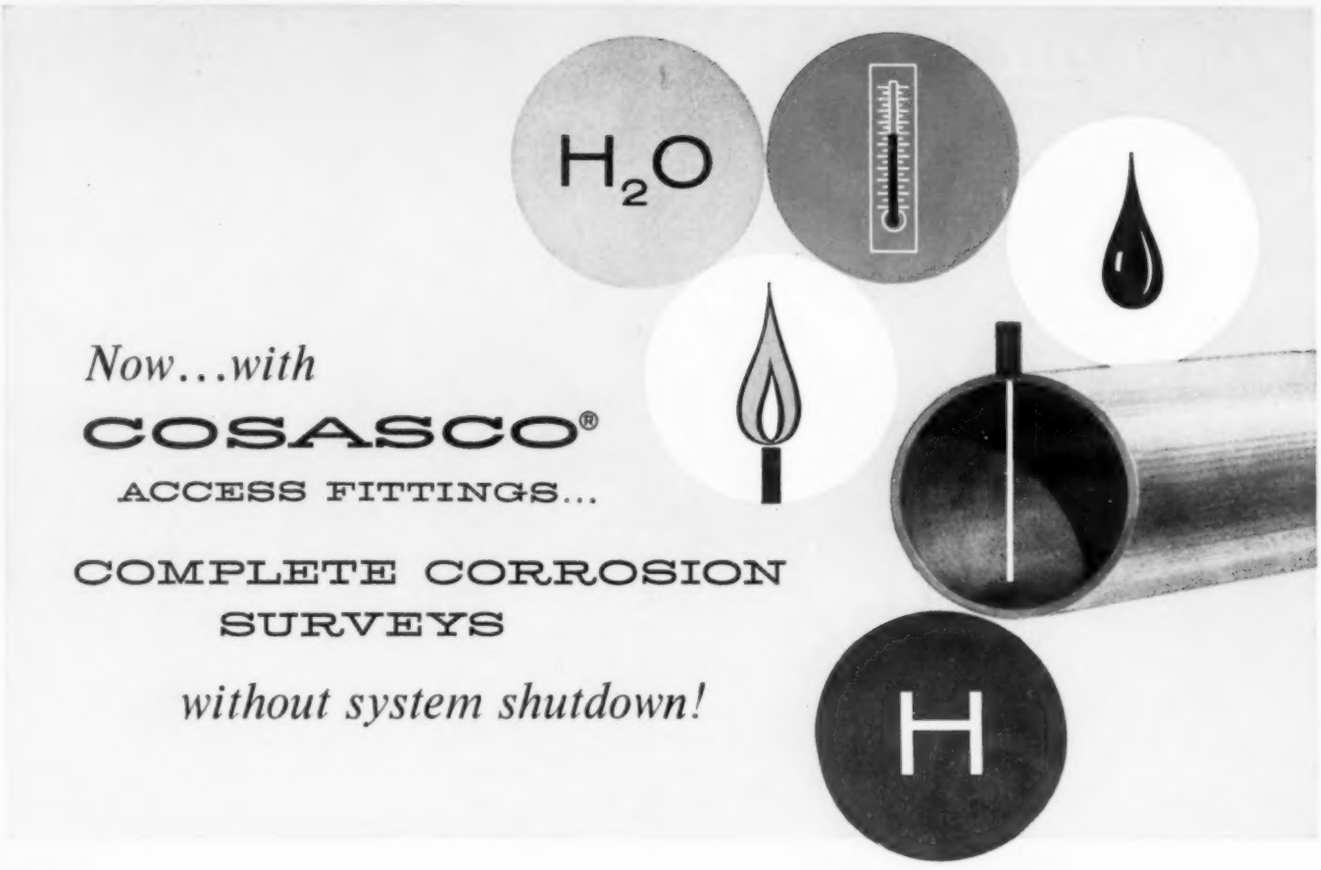

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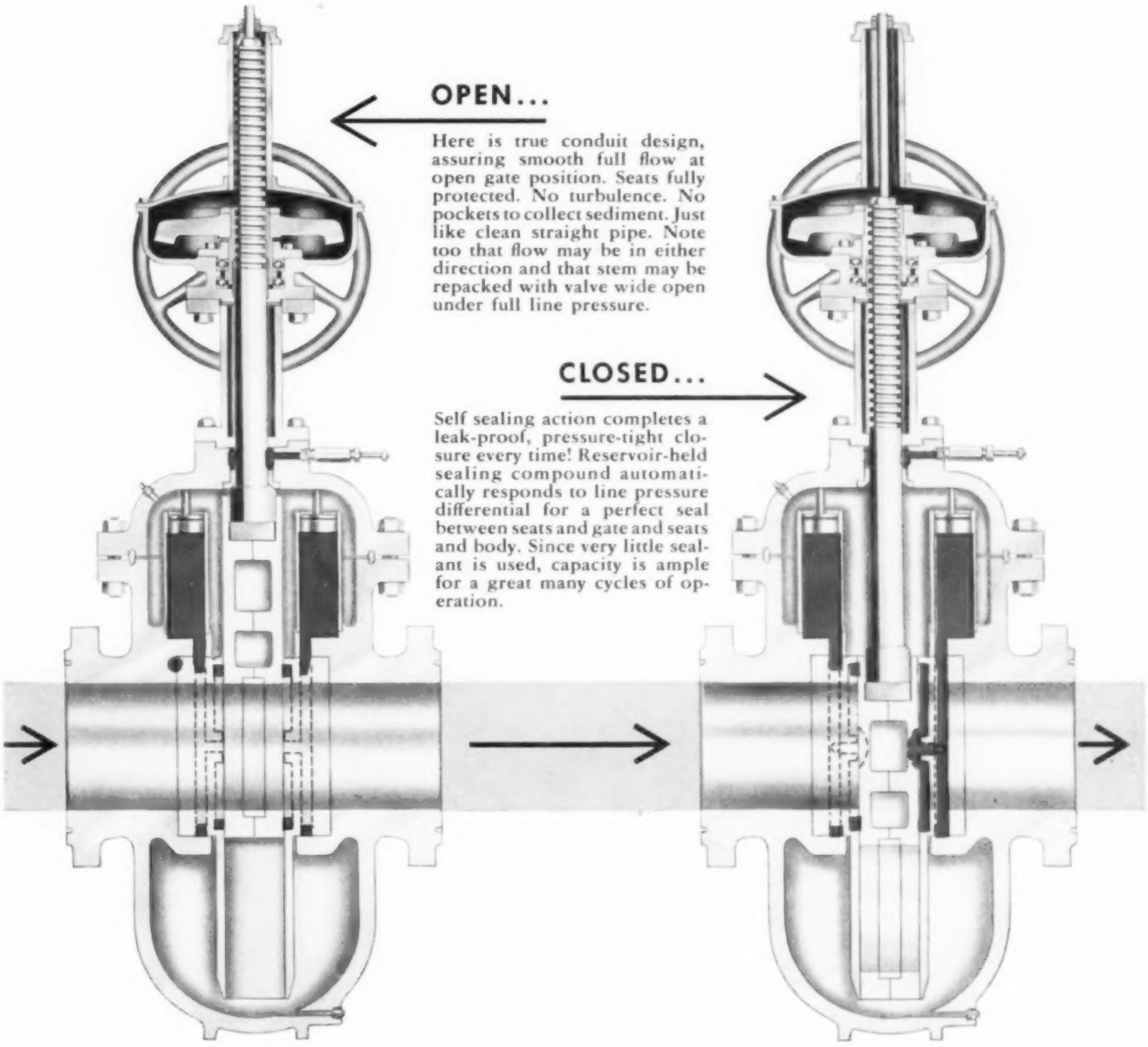

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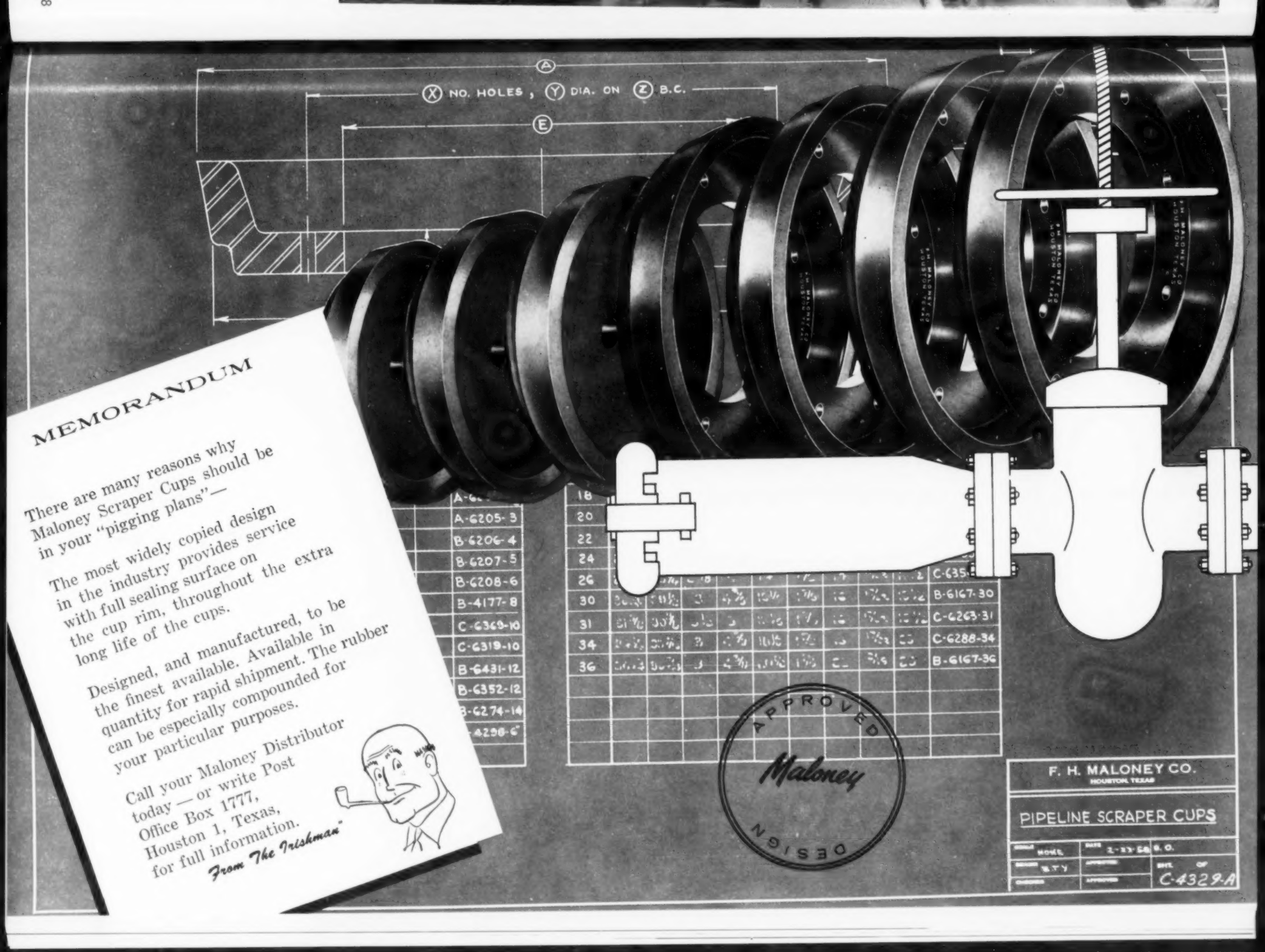
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ON line after line, in all types of terrain and soil, tough, durable *Pitt Chem* Coal Tar Enamels have *proved* their superior ability to provide sure, economical pipeline protection—year after year. But there's *another* big reason why so many companies specify *Pitt Chem* Pipeline Enamels. And that's Pittsburgh's Four-Way service program:

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3. Experienced Sales Service *Pitt Chem* sales representatives are experienced coating men. They talk your language, will help you plan the many requirements of your coating job.

4. Technical Service Pittsburgh maintains a full time staff of field service men to work with your field men in the efficient, economical application of coattings. *Write us about your protection requirements!*

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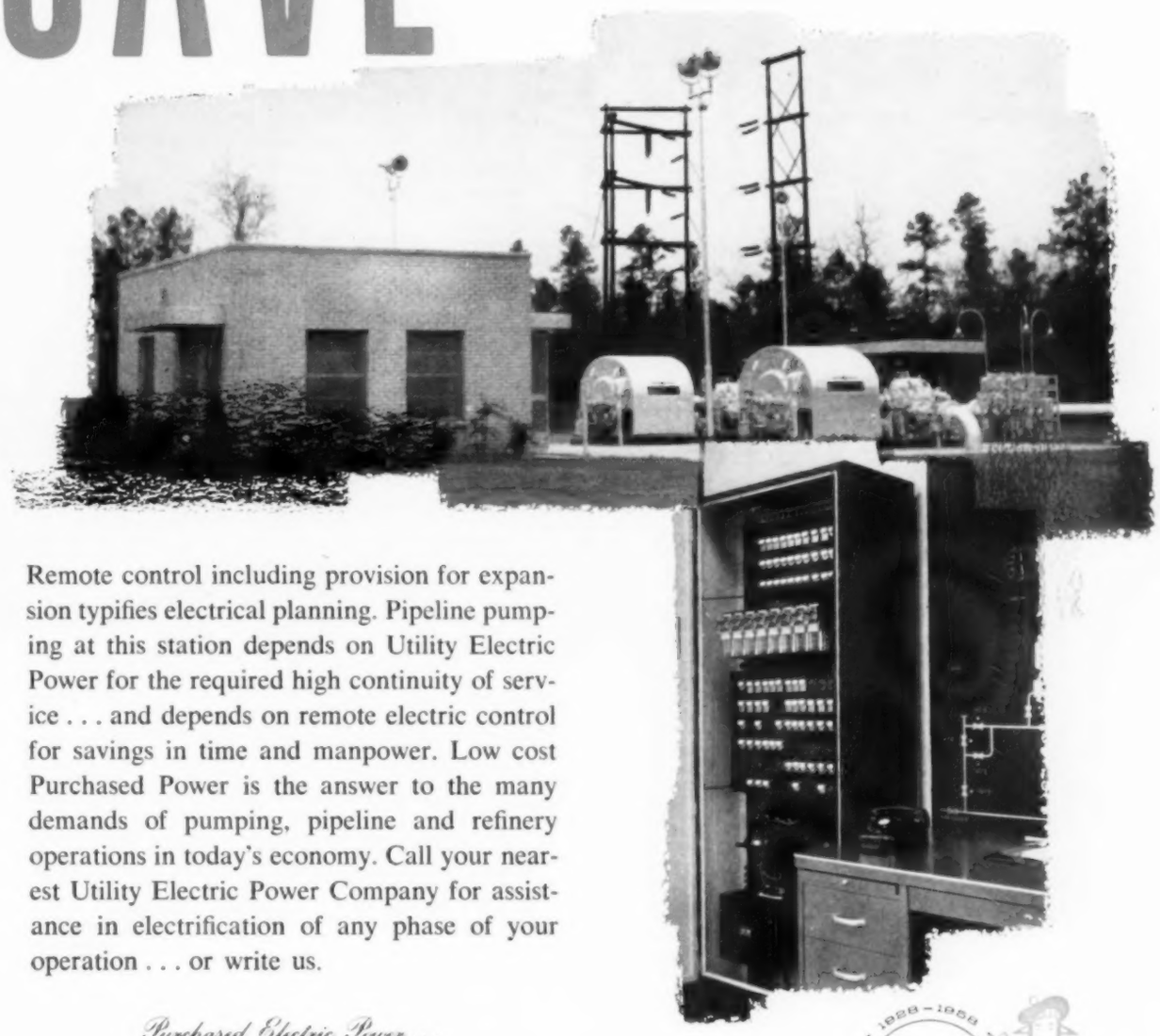

Remote control including provision for expansion typifies electrical planning. Pipeline pumping at this station depends on Utility Electric Power for the required high continuity of service . . . and depends on remote electric control for savings in time and manpower. Low cost Purchased Power is the answer to the many demands of pumping, pipeline and refinery operations in today's economy. Call your nearest Utility Electric Power Company for assistance in electrification of any phase of your operation . . . or write us.

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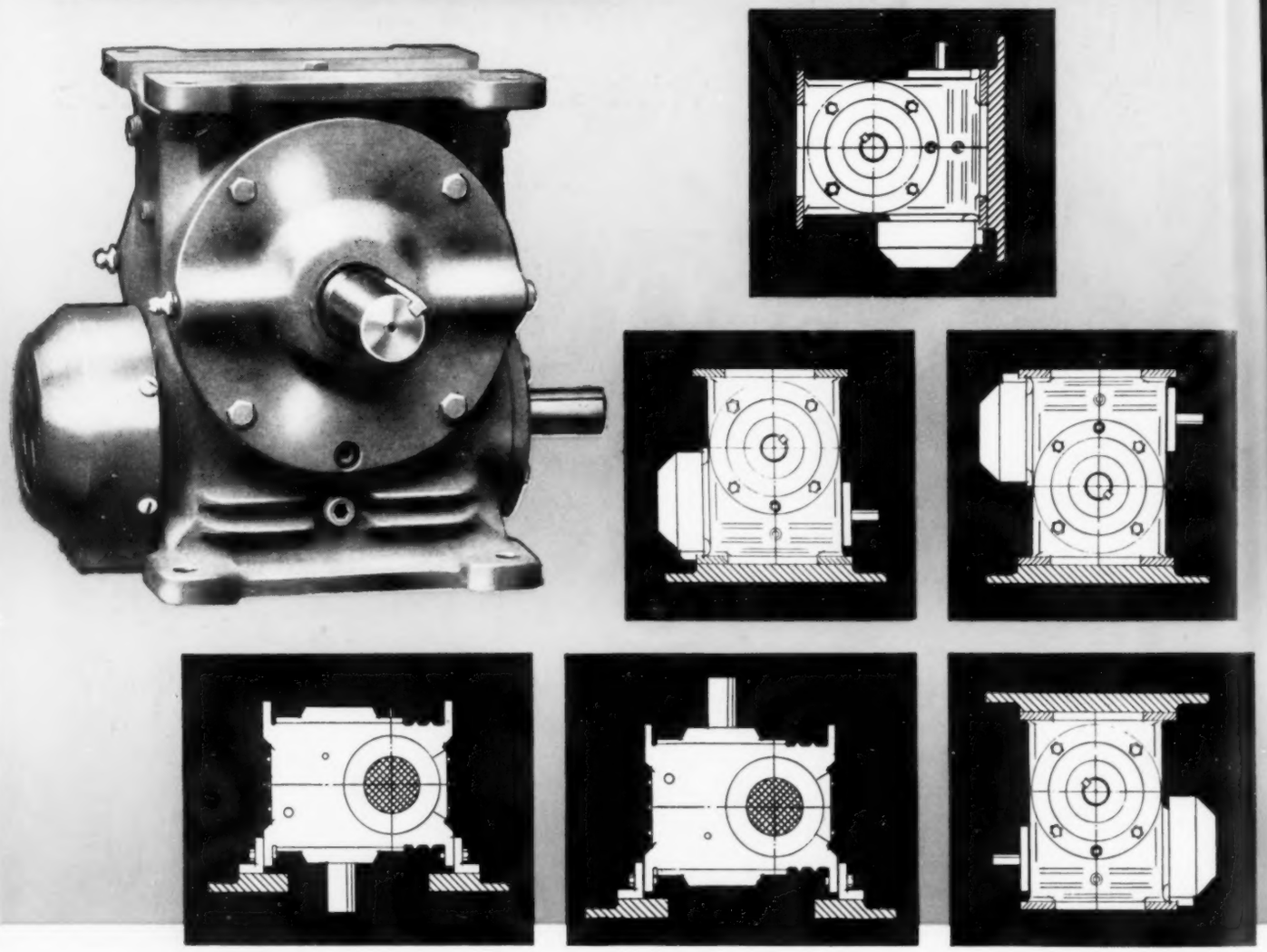
VERSO WORM GEAR SPEED REDUCERS

adapt to any mounting requirement



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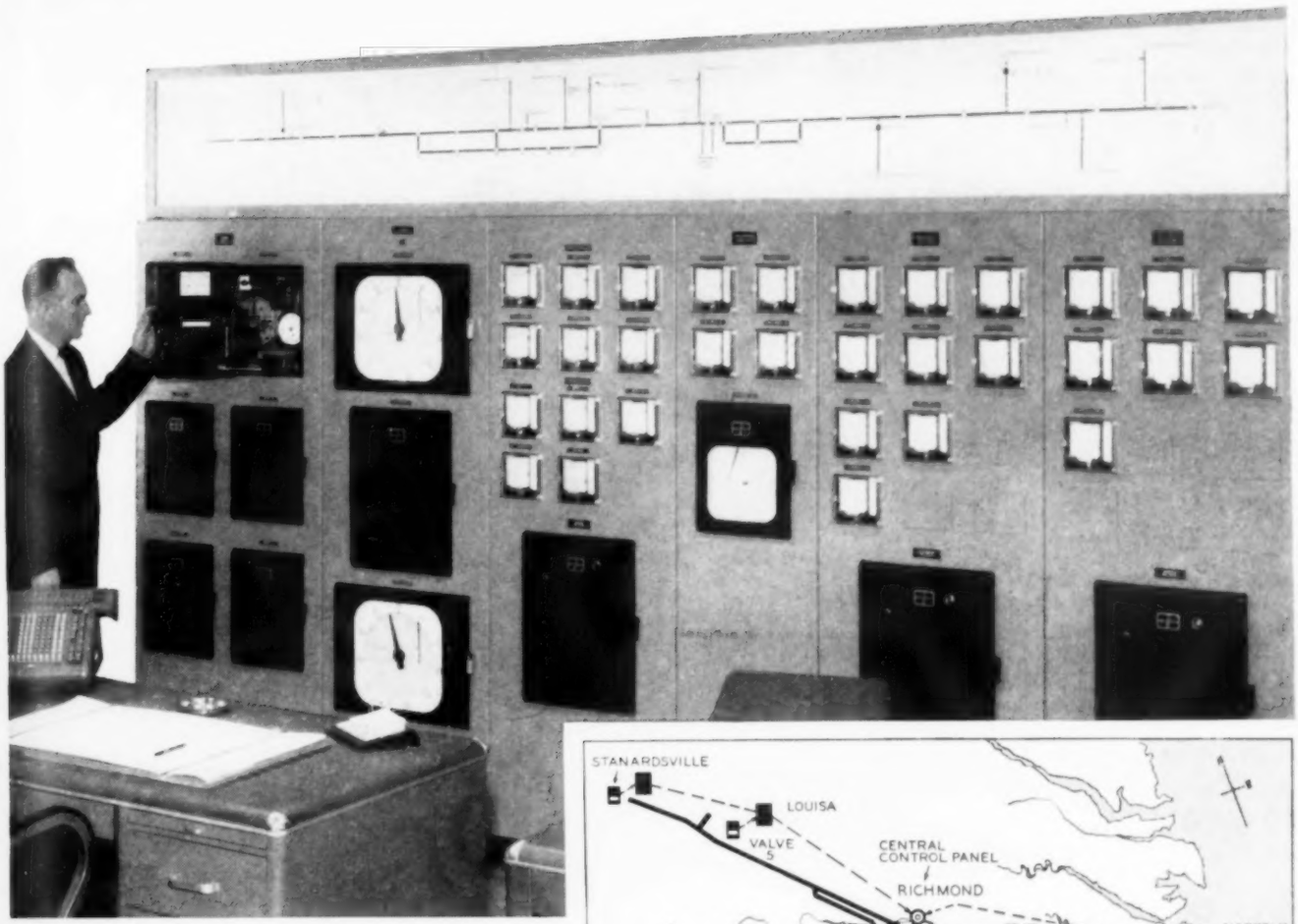

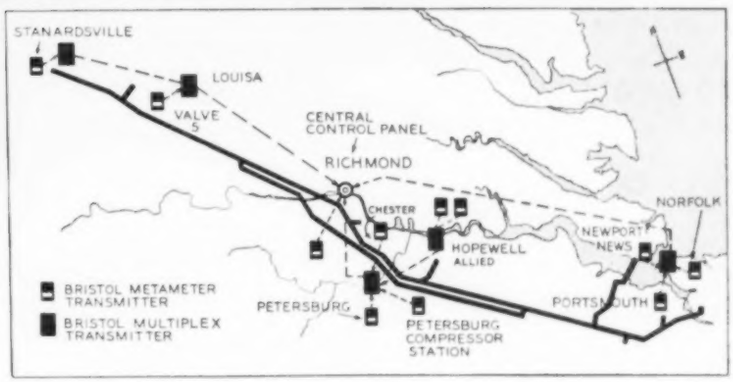

Schematic in top panel shows 300-mile pipeline system controlled by 31 Bristol miniatures, 13 full-sized Bristol instruments below. Map shows system ranging from Stanardsville in Northwest to Norfolk in Southeast Virginia.

Dispatcher's-eye view of a complex 300-mile pipeline system

From this panel of Bristol Metameter* telemeters, dispatchers at the Commonwealth Natural Gas Corporation of Richmond, Va., monitor natural gas supplied to the City of Richmond, The Petersburg and Hopewell Gas Company, The Virginia Electric & Power Company in Norfolk and Newport News, The Portsmouth Gas Company and several large industrial users, and also control the operations of the corporation's compressor station near Petersburg.

In addition, a computing system calculates, records and integrates the flow of gas and automatically corrects for pressure, temperature, specific gravity and supercompressibility so as to aid the dispatcher in approaching but not exceeding the demand figure. Flows, pressures, temperatures and specific gravity are continuously telemetered from critical points along the line. This Bristol telemetering system incorporates both direct wire and multiplexing systems, and uses both full-sized and miniature instruments. Bristol's complete line enables users to select the most economical and efficient unit for each specific application.

Advanced Bristol telemetering and centralized control increases reliability, steps up efficiency and reduces operational costs on any gas system. To find out how, write: The Bristol Company, 114 Bristol Road, Waterbury 20, Conn. 8.36

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*T.M. Reg. U.S. Pat. Off.

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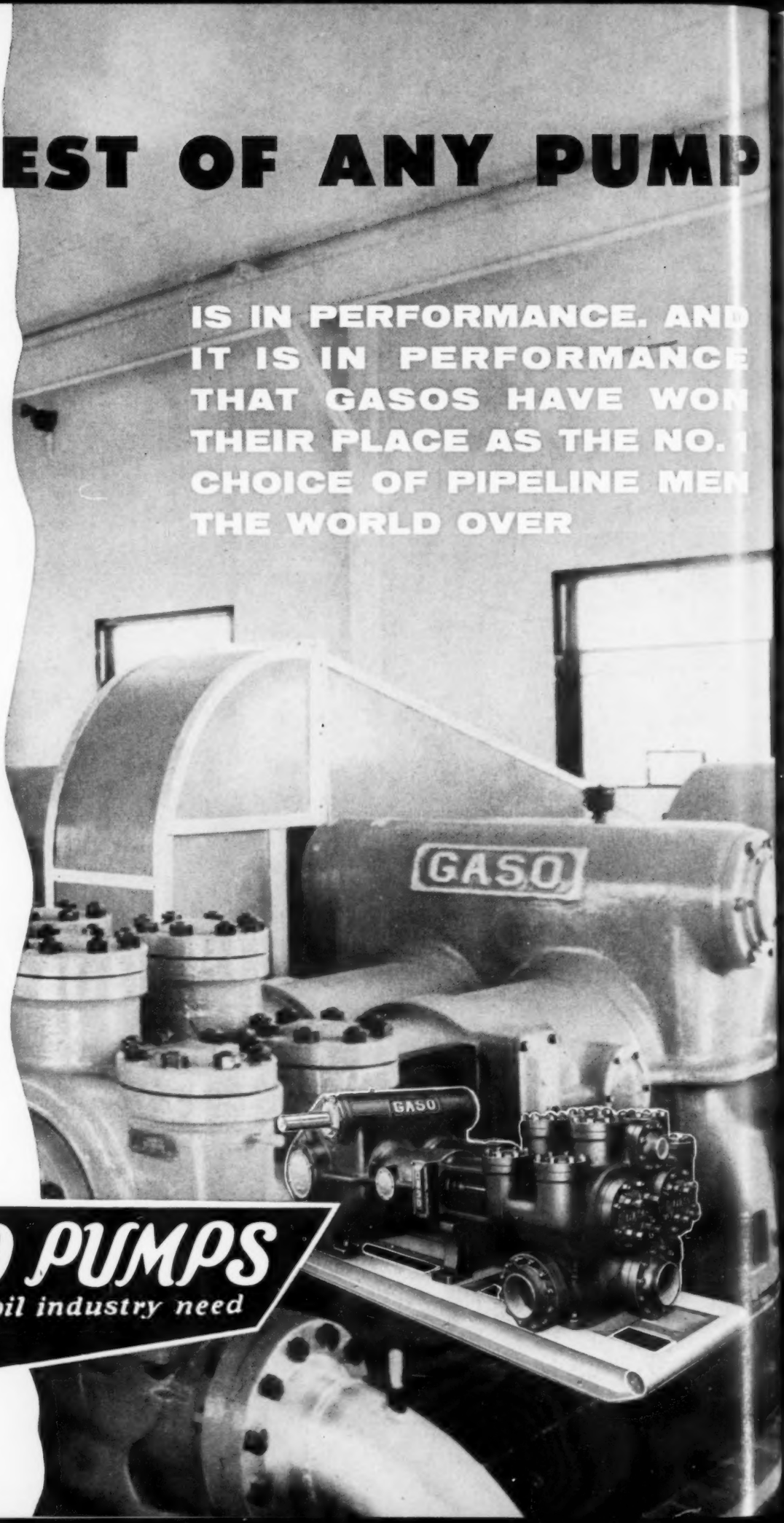

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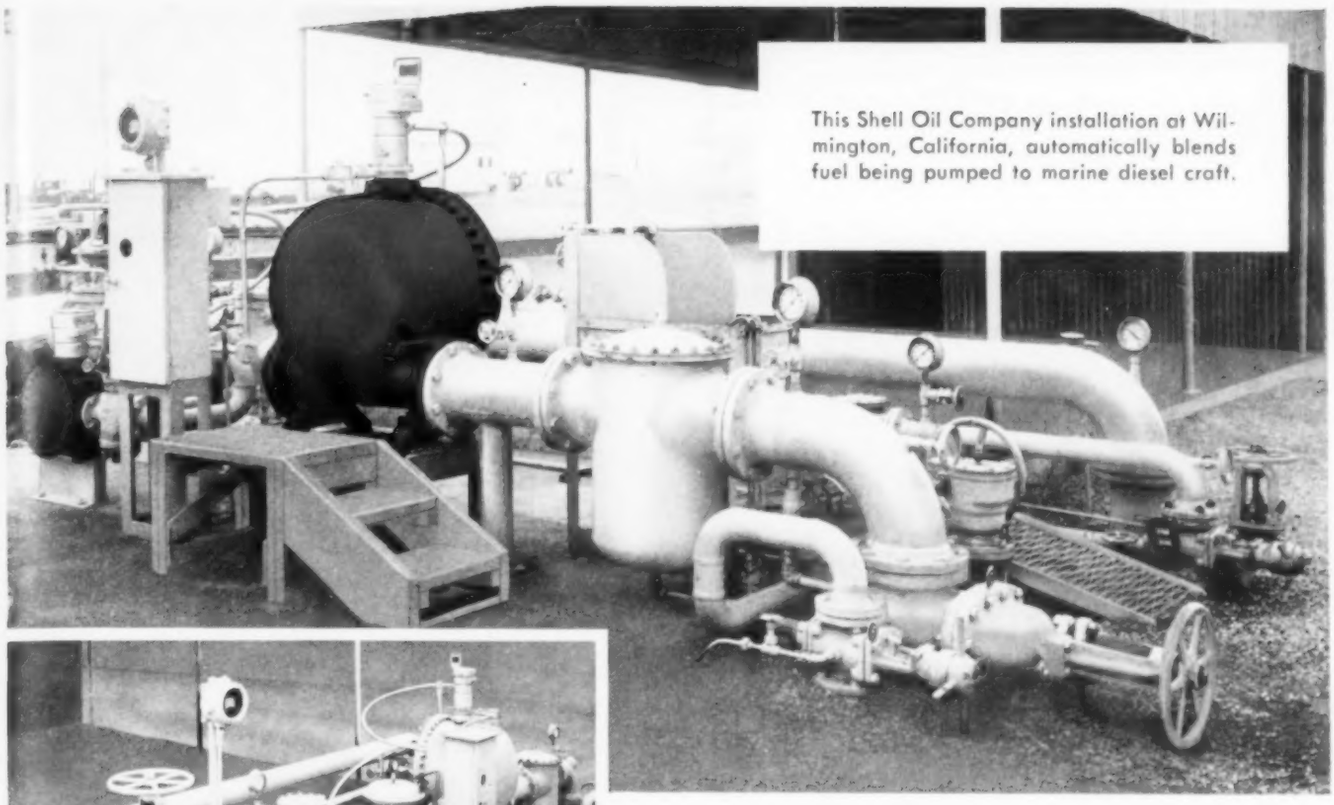
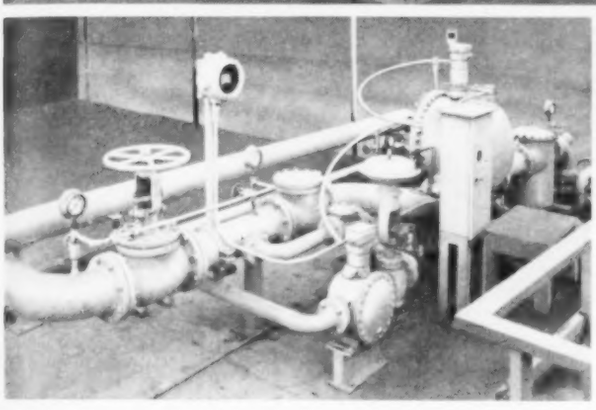


This Shell Oil Company installation at Wilmington, California, automatically blends fuel being pumped to marine diesel craft.



Cables from Brodie Meter counter drive takeoffs can be seen leading to control cabinet.

Blending in the line with the sustained accuracy of Brodie *BiRotor* Meters speeds dockside diesel fueling

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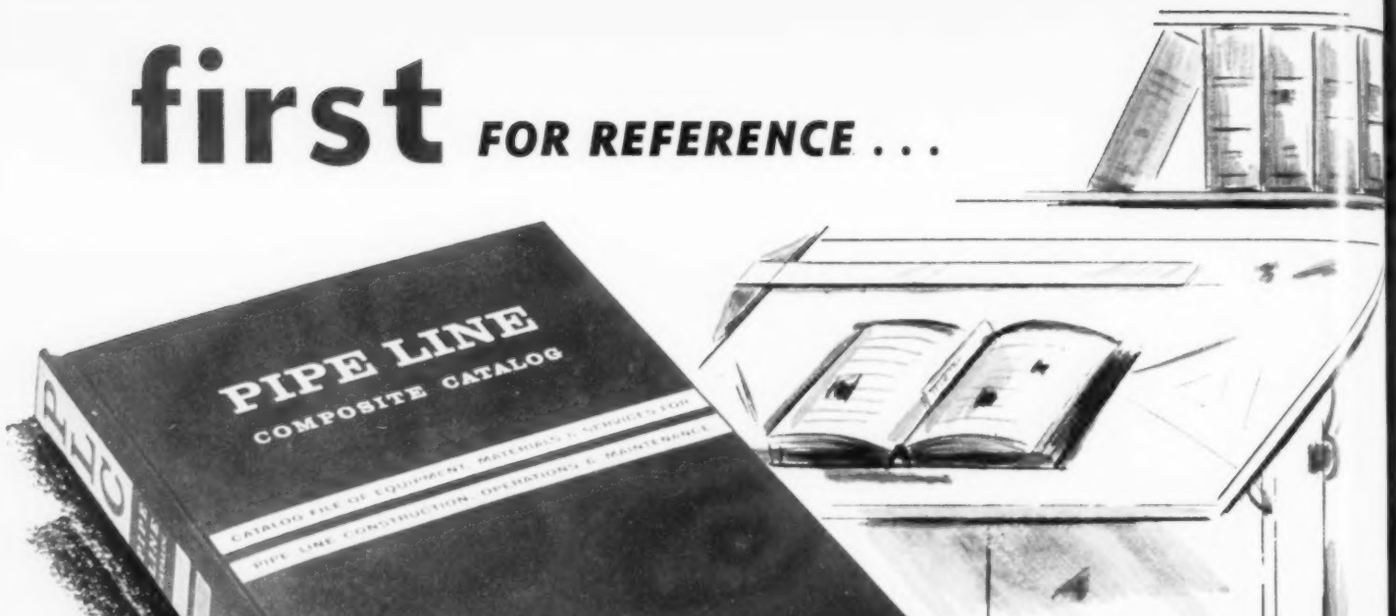

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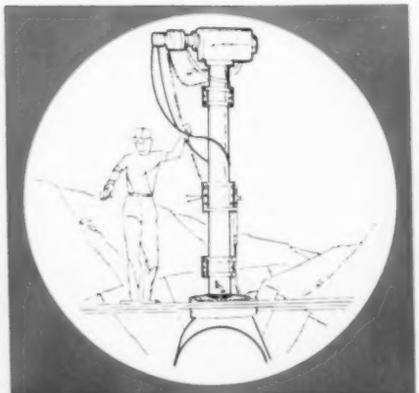

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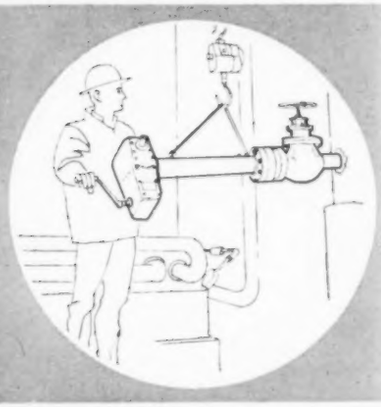

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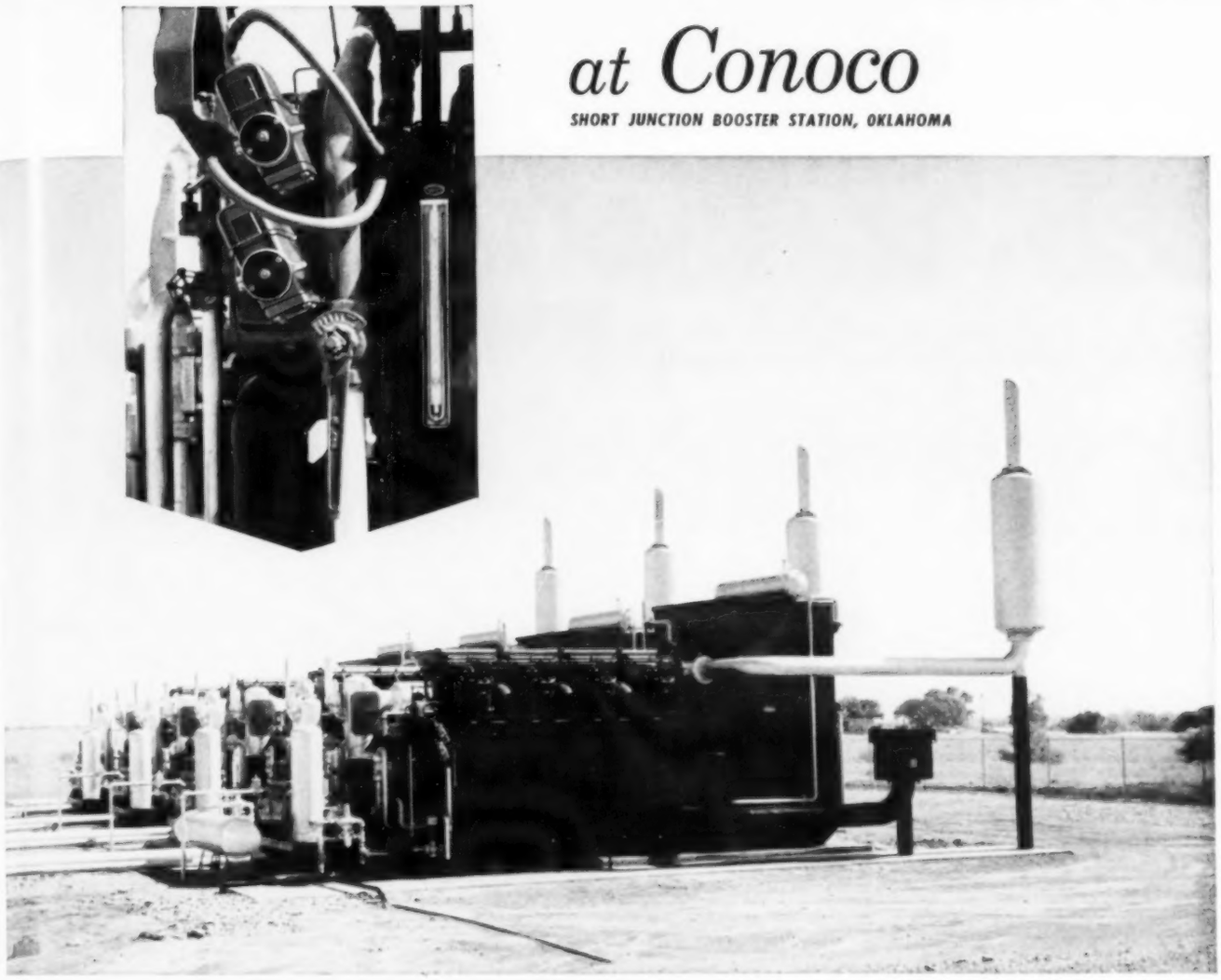

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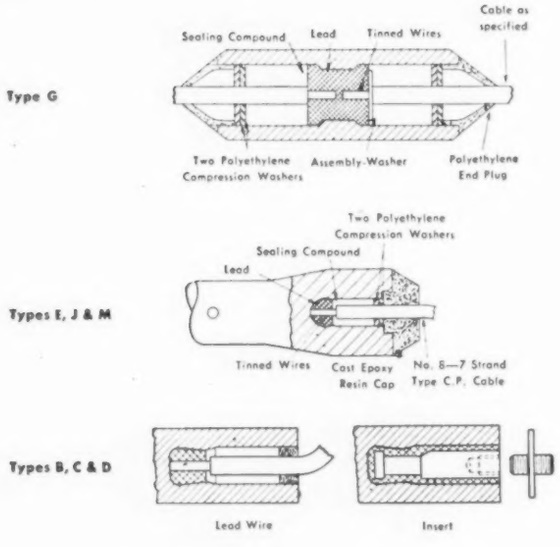

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G	2" x 9"	0.4	5	Ducts
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*Applicable also in fresh water service. Should not be used in ground beds without backfill.

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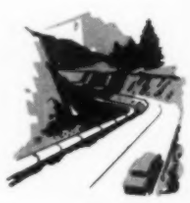

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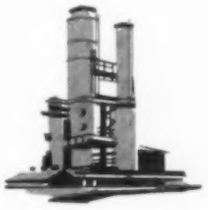

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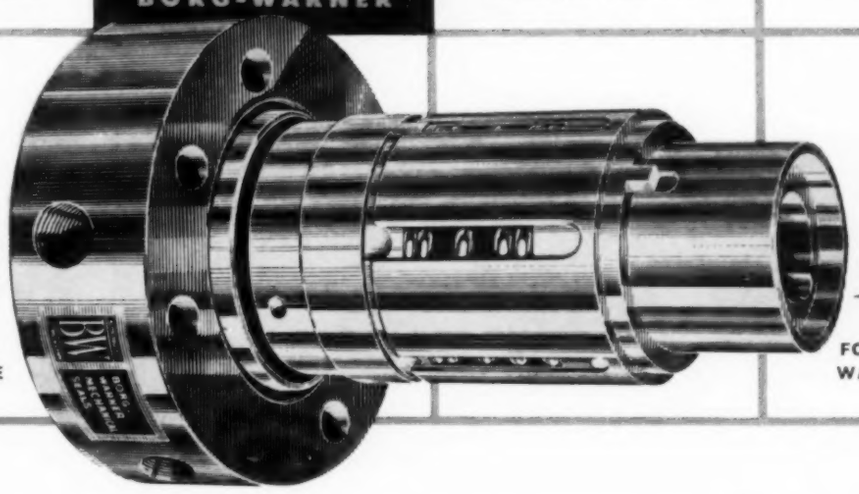

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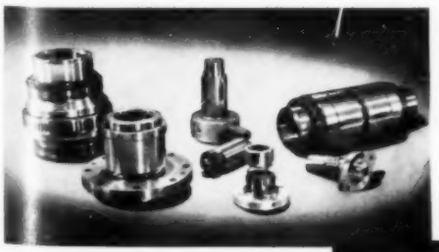

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Borg-Warner Mechanical Seals are now available for almost every make, model and size centrifugal pump . . . almost every pumping condition . . . and for other difficult rotating shaft sealing applications.

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This new Borg-Warner Mechanical Seal Division provides larger, more efficient sales, engineering, manufacturing and service facilities. It concentrates an even greater research and development program to create new and improved seals for tomorrow's shaft sealing needs.

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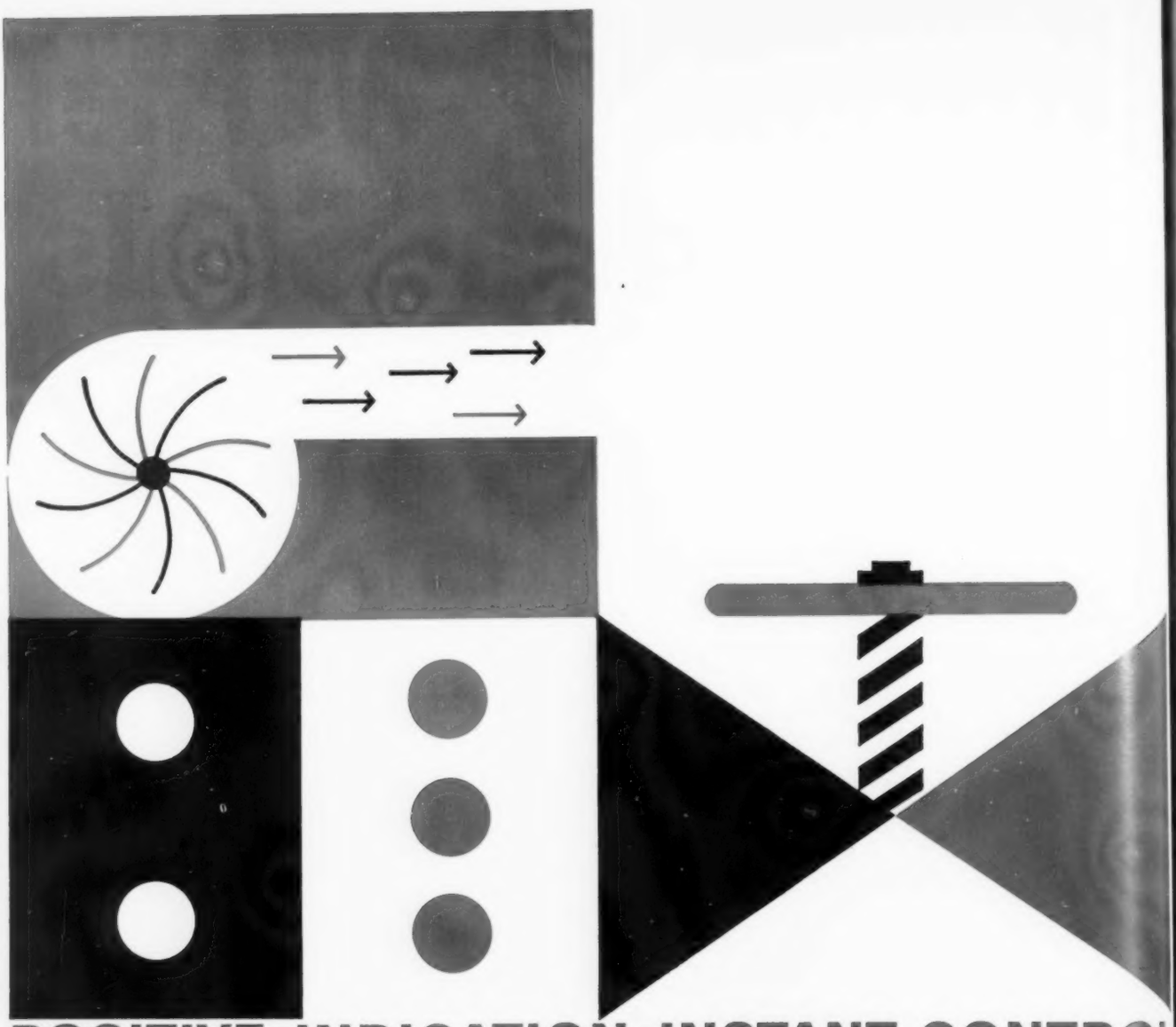

POSITIVE INDICATION-INSTANT CONTROL OF REMOTE PUMP MOTORS AND VALVES

S&J Gardtrol units continuously report actual conditions at remote points. They also allow instant change of conditions by the operator. Gardtrol Valve Monitor shows open, opening, closing, closed or stopped (partly closed) conditions. Gardtrol Pump Motor Monitor indicates on or off. Both have simple illuminated push button controls for all functions. Only one small wire—plus a common return—is needed between control unit and the field unit. S&J Gardtrol assures reliable supervisory control at lowest cost.

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SHAND AND JURS COMPANY 2600 Eighth Street, Berkeley, California

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DELIVERY WHEN AND WHERE YOU WANT IT . . .

ELECTRIC WELD LINE PIPE* from

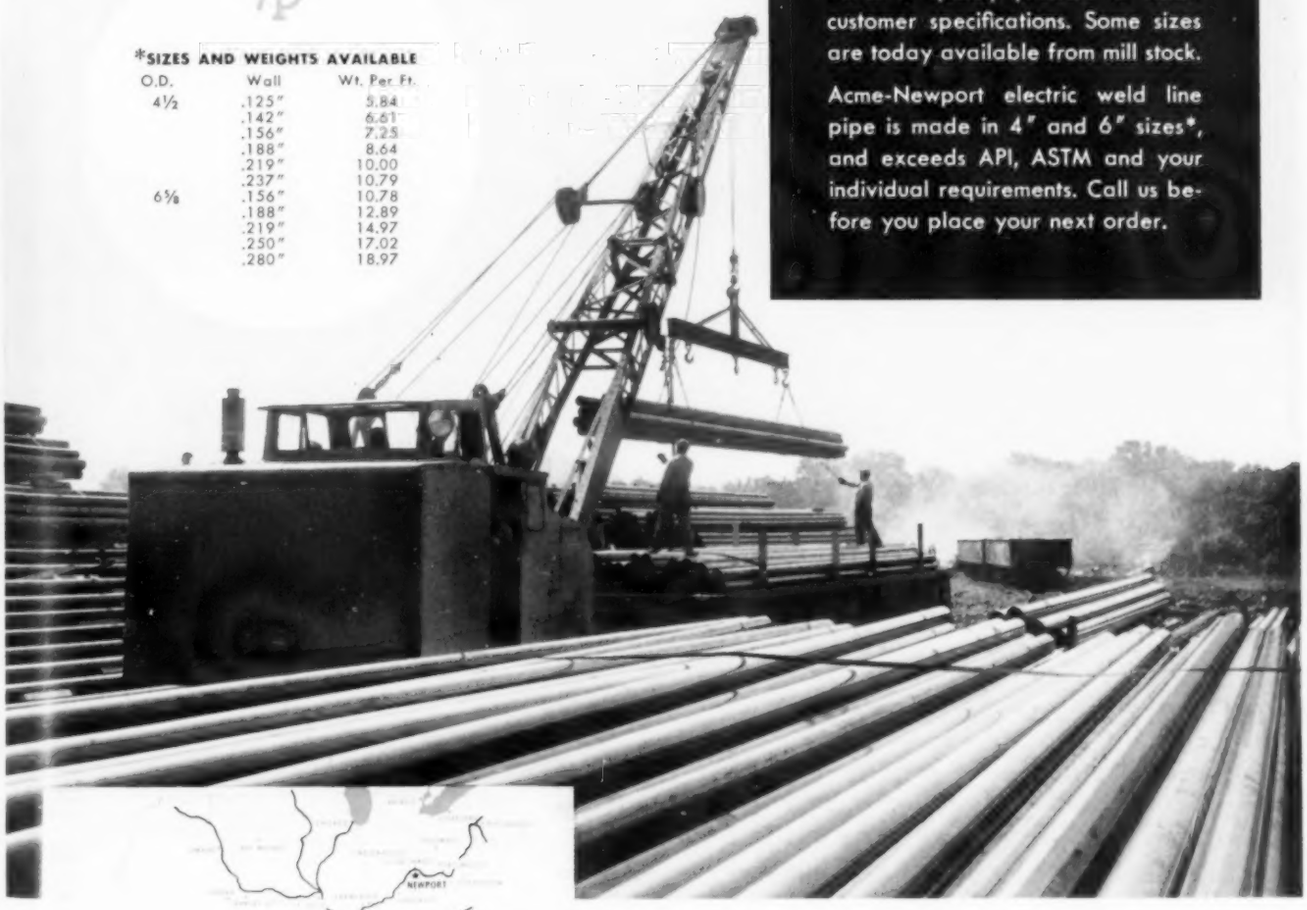
Acme-Newport Steel

Acme-Newport provides fast dependable service through modern facilities, conscientious personnel, convenient location and the inherent flexibility of an operation this size. These advantages enable this basic steel producer to ensure efficient mill scheduling and expedited service of a quality product to exact customer specifications. Some sizes are today available from mill stock.

Acme-Newport electric weld line pipe is made in 4" and 6" sizes*, and exceeds API, ASTM and your individual requirements. Call us before you place your next order.

***SIZES AND WEIGHTS AVAILABLE**

O.D.	Wall	Wt. Per Ft.
4½	.125"	5.84
	.142"	6.61
	.156"	7.25
	.188"	8.64
	.219"	10.00
	.237"	10.79
6⅝	.156"	10.78
	.188"	12.89
	.219"	14.97
	.250"	17.02
	.280"	18.97



ECONOMICAL WATERAIL-TRUCK DELIVERY

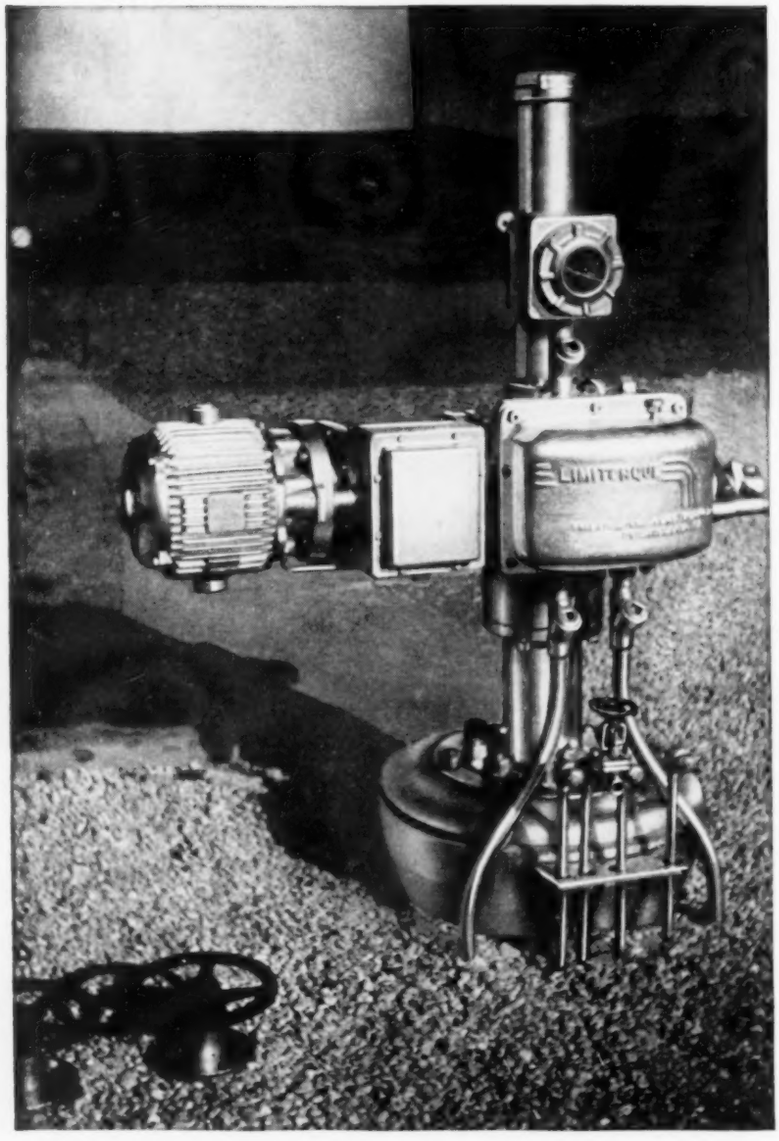
This Company is ideally situated on the Mississippi-Ohio River system and the great Cincinnati rail-truck hub. New barge facilities, 7 major railroads and 143 motor carriers enable Acme-Newport to give economical, dependable delivery to the entire area of the Middle West and South.

Acme-Newport Steel COMPANY

NEWPORT, KENTUCKY

A SUBSIDIARY OF ACME STEEL COMPANY

NOW...HIGH SPEED VALVE OPERATION... slow speed seating Advantages



The illustration shows a style HM LimiTorque with "Hi-Lo" attachment mounted on a W-K-M 16" series conduit valve for operation on a large oil pipeline. The particular Unit causes the valve to open the full 16" of travel in 12.5 seconds, and close the valve through the same distance in 2 minutes and 40 seconds.

WITH THE NEW Hi-Lo LimiTorque ATTACHMENT

LimiTorque now has available a complete new design "Hi-Lo" 2-speed attachment, which is a magnetic clutch actuated gear reduction unit. The "Hi-Lo" attachment is mounted between the motor and the LimiTorque housing, and permits operation at either of 2 "speeds", and is capable of changing speeds under load. It permits hi-speed valve operation and still retains the slow speed seating characteristics required by most valves.

The "Hi-Lo" attachment permits as high as 18:1 ratio in speeds, and is controlled either by pre-set limit switches or relays mounted in the LimiTorque Operator or by other control devices located on associated equipment furnished by us or others.

The "Hi-Lo" attachment to the LimiTorque Valve Unit makes it ideal for the special requirements of water works, oil refineries, and sewage treatment plants, etc., where normal operating conditions require low or medium speed operation, but under emergency conditions fast speed operation is a must. Line surge or hammer is reduced under emergency hi-speed operation by changing to low speed operation prior to seating. Further information available from Philadelphia Gear Corporation.

THERE IS NO SUBSTITUTE FOR —

LimiTorque®

PHILADELPHIA GEAR CORPORATION

ERIE AVE. & G STREET, PHILADELPHIA 34, PENNA.

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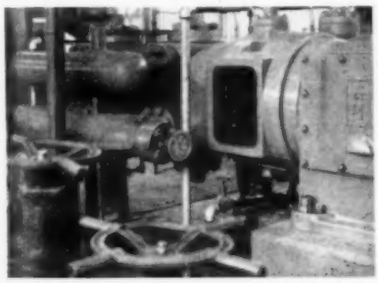
INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID AGITATORS • FLEXIBLE COUPLINGS

Limitorque Corporation • Philadelphia

Pointer oscillation only a minor reason for dampening of industrial thermometers

It is generally assumed that industrial thermometers are silicone dampened solely to prevent pointer oscillation when used on vibrating equipment. True, the prevention of pointer oscillation is necessary, but actually there are several far more important reasons for the use of silicone dampening fluids.

The primary reason for dampening bimetallic dial thermometers is to preserve accurate calibration, especially on the lower temperature ranges where a thinner bimetal element is used. An *un*dampened bimetal element, when subjected to shock or severe vibration, would have a tendency to unwind slightly, throwing the instrument out of calibration. To prevent this, thermometers are dampened by covering the bimetal element with silicone fluid. The silicone provides permanent protection for the critical bimetal element, holding the coil in place and preventing any unwinding or shifting action. This dampening, of course, also prevents pointer oscillation, eliminating difficult readings. But the primary reason for silicone dampening is to help maintain calibration accuracy, and it is therefore quite important to *all* industrial thermometer users.



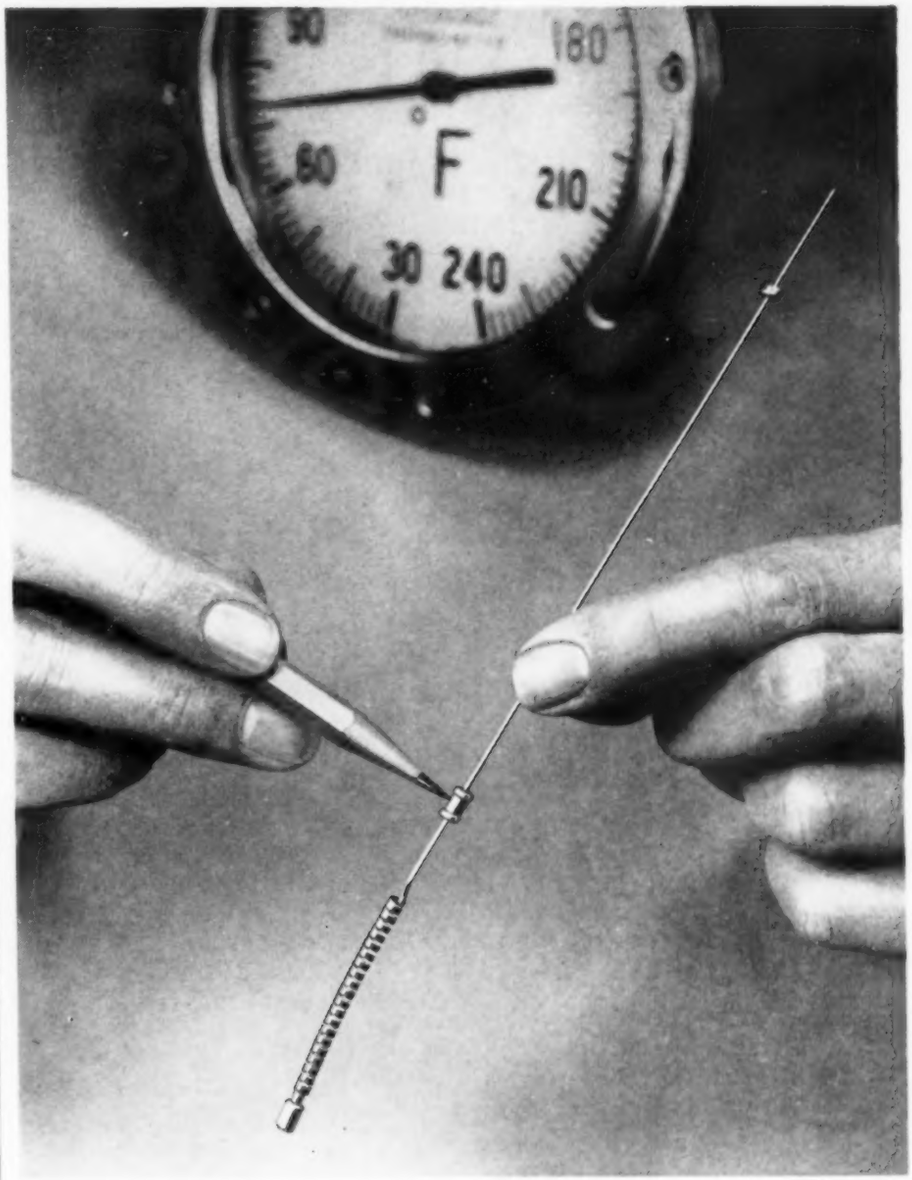
The RMC thermometer in this photograph is constantly subjected to extreme vibration. It is installed on a two-stage Synthesis Gas Compressor in Atlantic Refinery's Philadelphia Synthetic Ammonia Plant. Only a completely dampened thermometer could maintain its accuracy under such conditions.

There is more, however, to the full dampening story. Rochester Manufacturing Company carries this dampening procedure one step further with a specially designed bearing which further dampens both the shaft and coil. It also serves as a better guide for the bimetal shaft to keep it perfectly aligned within the tube. RMC is the only manufacturer using this type of dampening bearing at the present time.

RMC offers compensated electrical remote-reading liquid level indicator

A double coil movement in the RMC electrical, remote-reading liquid level indicator compensates for voltage changes. Silicone dampened and hermetically sealed.

Write, wire or phone—tell us your requirements for indicating instruments, and let RMC engineering skill go to work for you. ROCHESTER MFG. CO., 207 Rockwood St., Rochester 10, N. Y.



This special dampening bearing goes one step beyond silicone in the dampening of RMC thermometers. Only RMC uses this *extra* dampening device in addition to silicone and the usual stamped guide bearings. It is a precision machined part, serving several needed dampening functions.

Special bearing *plus* silicone double-dampens RMC thermometers

In RMC bimetal thermometers a specially designed dampening bearing is used just above the bimetal element. This bearing further dampens the shaft, helps to prevent coil unwinding and pointer oscillation, and also serves as a better guide for perfect shaft alignment within the tube. It's the combined use of this dampening bearing *and* silicone that makes RMC thermometers extra resistant to shock and vibration. You get this *only* in RMC industrial thermometers.

RMC

ROCHESTER MANUFACTURING CO., INC.
207 ROCKWOOD STREET • ROCHESTER 10, N.Y.

LIQUID LEVEL, TEMPERATURE and PRESSURE INSTRUMENTS

REPRESENTATIVES IN ALL PRINCIPAL CITIES

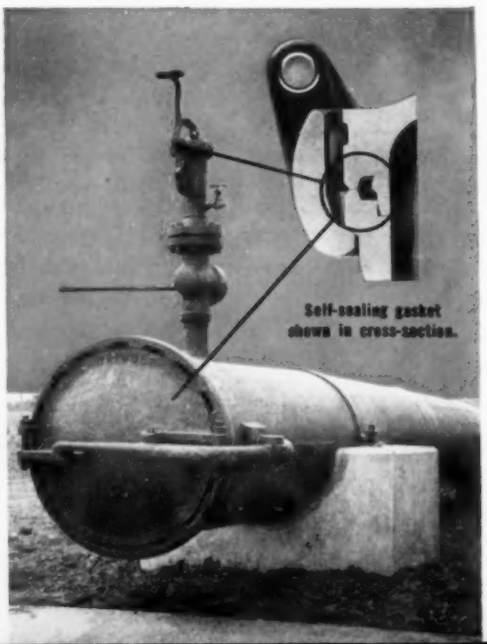
For more data on advertised products, use Readers' Service Cards, last page.

If you are a pipeliner

you'll appreciate this self-sealing gasket in UNIBOLT scraper trap and blowdown closures

Little things . . . like the gasket for a scraper trap or blowdown closure for example . . . can be a big headache. But not this one. It is the self-sealing gasket used in UNIBOLT pipeline couplings. The UNIBOLT design makes line pressure do the sealing. And this design practically encloses the gasket in steel so that when the closure is opened and closed the gasket is hardly disturbed. Made of oil- and gas-resistant Hycar nitrile rubber, this gasket will last indefinitely under normal conditions.

UNIBOLT scraper trap and blowdown closures are hinged for easy operation. Release only two bolts and the closure swings open and shut like a door. No heavy lifting. No time-consuming multi-bolt flanges. See our detailed data in Pipe Line Composite Catalog and write or wire for any needed information.



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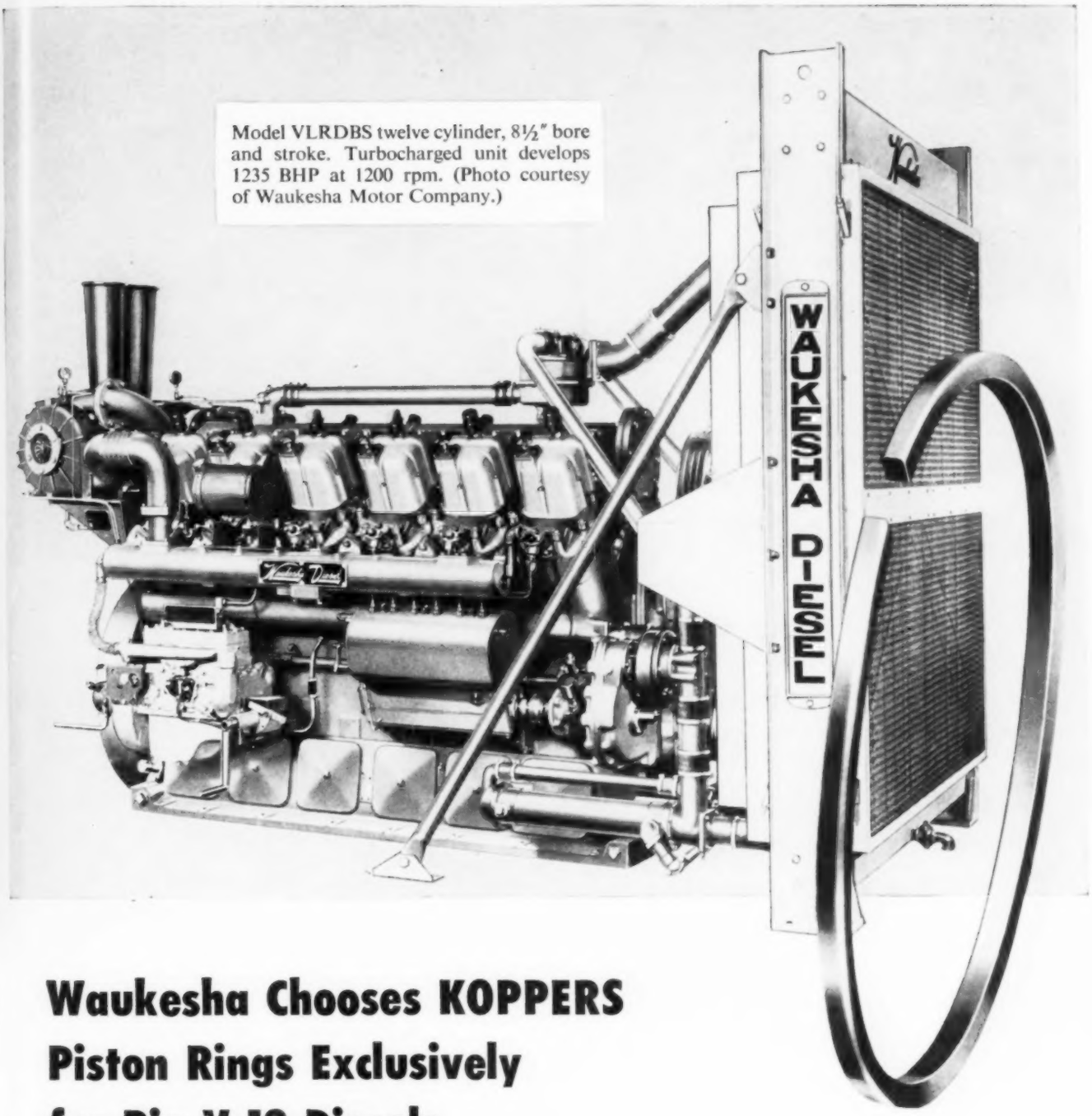


Model VLRDBS twelve cylinder, 8½" bore and stroke. Turbocharged unit develops 1235 BHP at 1200 rpm. (Photo courtesy of Waukesha Motor Company.)

Waukesha Chooses KOPPERS Piston Rings Exclusively for Big V-12 Diesels

Waukesha's VLRDBS supercharged diesels are perfectly suited for applications such as oil rigs, excavators and tugboats where a surge of reserve power is essential for emergency and overload demands.

This recent series of diesels manufactured by the Waukesha Motor Company, of Waukesha, Wisconsin, is designed to develop tremendous power under the severest operating conditions . . . the kind of power that puts a premium on piston ring performance. Waukesha has selected Koppers Piston Rings as have other manufacturers who must be certain of reliable component performance.

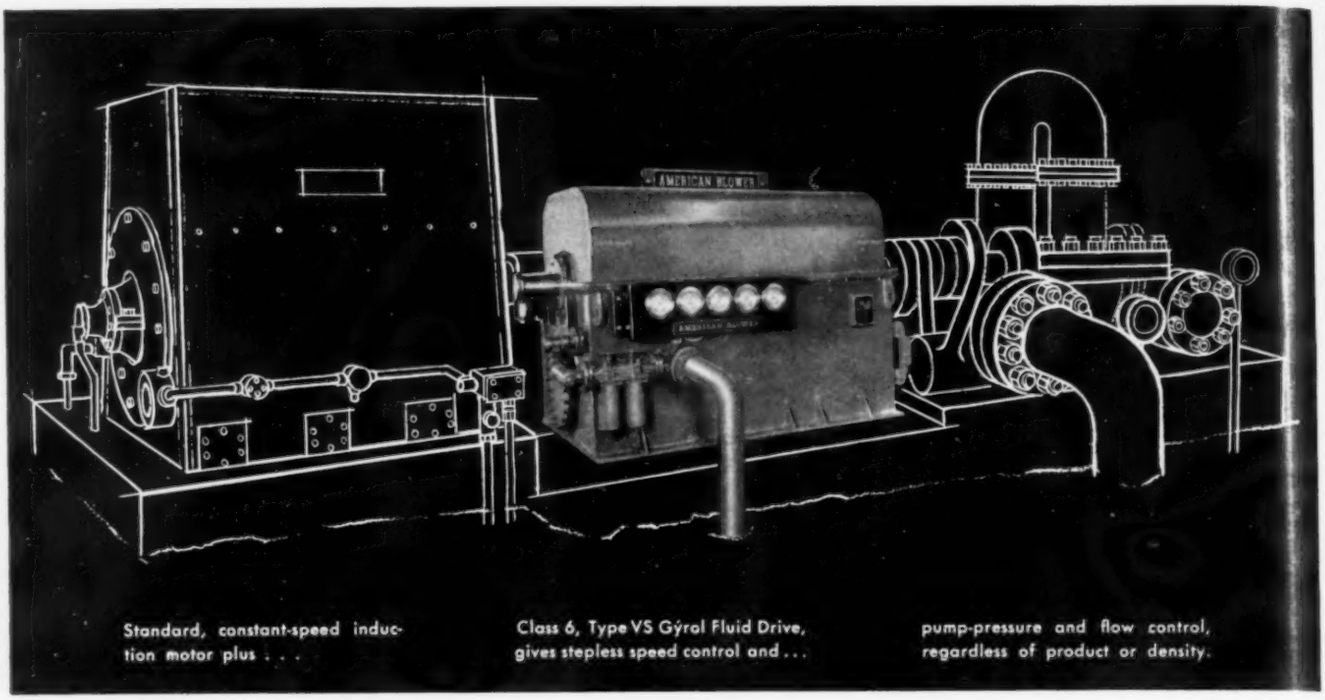
This dependability is yours when you rely on Koppers with their complete range of materials . . . wide selection of types and sizes . . . rigid quality control and careful inspection. These factors contribute to Koppers unchallenged leadership in producing the finest piston and sealing rings for industry.

Instead of undergoing needless expense in solving ring problems, take advantage of Koppers experience, research facilities and craftsmanship. Write for information today. KOPPERS COMPANY, INC., Piston Ring and Seal Dept., 7211 Hamburg St., Baltimore 3, Md.

★ **KOPPERS DEPENDABLE RINGS CONTRIBUTE TO WAUKESHA'S RELIABLE PERFORMANCE UNDER THE MOST RUGGED CONDITIONS.**

KOPPERS

AMERICAN HAMMERED
Industrial Piston Rings
Engineered Products Sold with ***Service***



Standard, constant-speed induction motor plus . . .

Class 6, Type VS Gýrol Fluid Drive, gives stepless speed control and . . .

pump-pressure and flow control, regardless of product or density.

Lower your pipeline pumping costs with American Blower *Gýrol*® Fluid Drive

Stepless speed control ends throttling losses; gives complete flexibility of flow and pressure

Power savings up to 25% are possible when you equip centrifugal pumps with American Blower Gýrol Fluid Drive! Coupled with a standard, single-speed induction motor, the stepless, adjustable-speed Gýrol Fluid Drive controls flow and pressure without throttling; gives desired output at lowest power consumption.

Gýrol Fluid Drive also makes possible other major savings:

- Cost of throttling valve eliminated
- Equal flexibility with fewer units
- Lower maintenance cost; less pump wear
- No-load starting; lower demand charges

And Gýrol Fluid Drive brings important operating benefits:

- Complete flexibility—exact control, regardless of rate-of-flow required by changes in viscosity, specific gravity, seasonal demand
- Line protection—keeps line pressure within design limits
- Pump protection—holds minimum suction pressure

FOR FULL INFORMATION, contact one of our 73 branch offices; or write: American-Standard,* American Blower Division, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

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PIPE LINE PANORAMA

Batch Detection—Pro and Con . . . Recent symposium brought out several challenging thoughts on interface detection instruments (See Page 36). *Thought one:* Present systems are not reliable enough for unattended operation. *Thought two:* Two important properties are often lacking in instruments now available—sensitivity and reliability. *Thought three:* Systems are now being tested which show considerable promise for the future. For example:

- Great Lakes Pipe Line has field tested gravity recorder and several capacitance instruments on its products lines. Capacitance is showing higher sensitivity, but less stability than gravity recorder.
- Salt Lake Pipe Line is using radioactive isotopes to mark interfaces between products in its Salt Lake to Spokane line. Radiation protection and absorption problems commonly associated with this precise marking method have been handled successfully.
- Plantation Pipe Line has laboratory tested an instrument that indicates difference in refractive indexes of different products. Field tests will be conducted in near future.

Four More Big Inch Gas Lines Forecast . . . Recent consumer study shows probable need for at least four more 1,000-mile, 30-inch gas lines by 1963 or 1964. Report also warns pipe line industry to make all-out effort to keep construction and operating costs in line. It now costs an average of $4,000 per inch diameter to lay mile of pipe across normal terrain, while operating costs are ranging from 1½ to 1¾ cents per Mcf per 100 miles.

Automatic Welding System Shows Promise . . . After three years of field tests, new German-made automatic welding system appears ready for cross-country pipe line construction use (See Page 42). Snapped over the joint like a giant caterpillar, it holds rod in the bevel and controls weld progress by electromagnetic force. U. S. shop demonstrations indicate new methods may eliminate many of the problems inherent in conventional welding, i.e., weather, welder fatigue.

Custody Transfer Proving Its Worth . . . Oil handling by lease automatic custody transfer is steadily winning new converts. During three month period (April-July), Arapahoe Pipe Line received 743,058 barrels through Pure Oil's metering units at Adena J Sand unit near Morgan City, Colorado—20 percent of the total crude handled by this method. (See Page 46).

Pure Oil reports five money and time-saving advantages of automatic custody transfer: Allows production to be transferred to central plant, eliminates storage tanks, provides improved visual indication, protects from bad oil, and greater safety.

Shale Gas for Pipe Lines? . . . Researchers at Institute of Gas Technology report they have a process to produce high heating value pipe line gas from hydrogenated shale. Report adds that process is a technical reality now and may become economic reality in not too distant future.

New Way to Make Underwater Repairs . . . Interstate Oil Pipe Line has successfully field tested new type caisson for underwater connections and repairs. Tests indicate that 16,000-pound, bell shaped caisson will eliminate disadvantages of present underwater tapping and repair methods. (See Page 72).

What We Need For Better Batch Interface Detection

Engineers of four pipe line companies discuss their experience with instruments now available. Their results provide a look at some of the progress being made toward development of reliable interface detectors

INCREASED INTEREST in automation is causing a more critical look at batch interface detection instruments. General consensus of engineers today is that present systems are not reliable enough for unattended operation. Two properties which seem to be lacking in instruments now are sensitivity and reliability.

Representatives of four pipe line companies discuss their experience with various types of interface detection instruments, both operational and experimental. While the most interest is shown by products pipe line companies, with the increase in automatic custody transfer crude oil pipe lines are becoming more concerned.

By C. W. Blackburn
Phillips Petroleum Company
Bartlesville, Okla.

"All of the interface detection systems we have are deficient in one or more points and some are quite seriously deficient"

PHILLIPS USES several makes and several types of interface detectors for various applications. In one pipe line terminal handling crude oil, natural gas liquids and 12-pound natural gasoline, we use a system to detect interface passage in which the instrument measures the change in amount of radioactive energy penetrating the product. One good feature of this system is that all the required equipment is mounted externally, on or near the pipe line, allowing easy installation and simplifying maintenance.

For completely automatic operation batch interface detection instruments must meet these demands . . .

1. Reliability—suitable for unattended operation
2. Ruggedness—suitable for industrial duty
3. Means for external adjustment
4. Means for testing without disturbing the external block
5. Adequate junction space, with a terminal block
6. Hermetically sealed relays
7. Disconnecting means
8. Insensitivity to, or compensation for, temperature change
9. Enclosures and general construction suitable for various classes of location and ambient conditions
10. Probe construction adequate for high-pressure systems (in case of probe-type systems)
11. Reasonable price
12. Means for simple installation and maintenance
13. Sensitivity, accuracy, reproducibility and stability suited to the application

A small capsule of cesium-137, mounted in a sealed can, is strapped to the pipe. Gamma radiations of relatively low energy (.662 mev.) are produced by this capsule which has a half life of about 30 years, and is designed to provide the desired sensitivity and stability. On the other side of the pipe, diametrically opposite to the cesium capsule, is a measuring cell which converts the radioactive energy it receives directly into electrical energy. This electrical signal is then converted, amplified and fed as a positioning signal to a recorder pen. Since the change in density of the liquid causes more (or less) radioactive energy to be absorbed, the remaining amount of energy which reaches the measuring cell is the key variable. An adjustable limit switch on the recorder is used to actuate an alarm, which alerts the operator to perform certain remote valve operations as required. Automatic valve operation, which may be desirable for some jobs, is not a practical thing here due to several operating conditions which change daily.

Dielectric Constant Detects Interference. In our product terminals where large cavern facilities have either been mined or dissolved in salt formations, we use several makes of detectors to sense the passage of the interface between salt water and propane or other hydrocarbons. In these instruments, the change in dielectric constant of the product as the interface passes produces a change in capacitance (in a probe). This change in capacitance is then fed into an oscillator circuit, changing the level of oscillation. The change in flow of current in a plate circuit of this oscillator energizes a sensitive relay and pilots an alarm relay. In these cases the interface passage causes an alarm to sound and a light to come on, allowing the operator plenty of time to operate valves or control pumps. Since these are more or less emergency warning functions and since they very seldom occur, it was considered uneconomical to utilize the alarm contacts to perform automatic control functions directly.

Detector Changes Set Point. Still another series of cases in which we use interface detection is the one in which a suction controller "set-pointer" is changed to a pre-set position whenever a slug of propane approaches the station. The same type of capacitance probe, sensitive to change of dielectric constant, as described in the previous case, is used. In this case, however, the sensitivity requirement is greater because the spread of dielectric constants of the whole range of product handled by this line varies only slightly (about 1.600 to 2.100 depending on temperature).

Specific Gravity Least Sensitive. The last type of interface detector which I will mention is one which depends on the *specific gravity* of the product. The bypass sampling of product which is continually flowing through the instrument is constantly being weighed on a set of mechanical scales, and the motion of the balance arm is linked to a recorder pen. The simplicity and relative low cost of this system are favorable, but its accuracy is not good enough to initiate automatic product transfer. Another disadvantage of this system is its inherent inability to discern between different products having the same specific gravity.

Reliability Important Feature. Judging from the experience we have had on several types and makes of interface detectors, the capability which seems to be most lacking is *reliability*. In one instance the calibration would shift due to tube aging; in another the calibration would change when the cover was put on. The reliability of some systems is satisfactory, but the price seems excessive considering the relatively simple job to be done. All of the interface detection systems we have are deficient in one or more of these points and some are quite seriously deficient.

Since interface detection is such an important function in pipelining we feel that present equipment available to do the job will require a great deal more development work before it will be considered acceptable as a reliable control system component.

By R. R. Hancox
Great Lakes Pipe Line Company
Kansas City, Mo.

"To select a detector best adapted to our system, we are investigating a new flagging material with automatic injection and detection"

FOR MORE than five years, Great Lakes Pipe Line Company has actively pursued an investigation into the problem of interface detection. Since Great Lakes transports only refined petroleum products we are concerned with the following types of interfaces; (1) fuel oil—fuel oil, (2) gasoline—fuel oil and (3) gasoline—gasoline. Large differences exist in several physical properties for the first two types of interfaces. We have found these

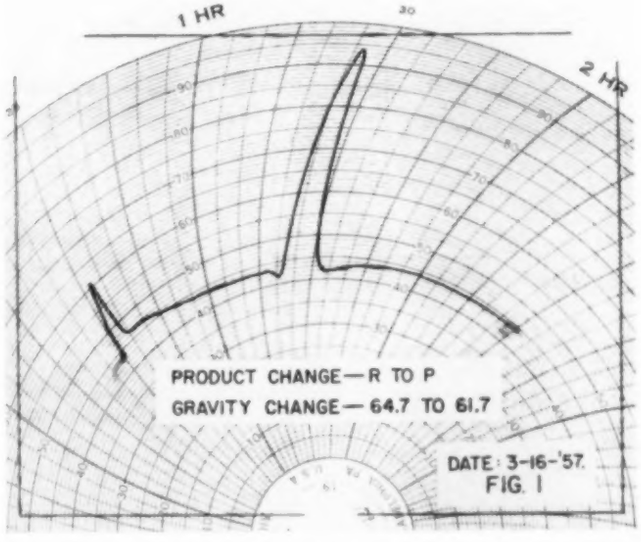


FIGURE 1—New design of dielectric indicator has a straight capacitance bridge with identical cylindrical condensers through which product flows forming two arms of the bridge. With the same product in both condensers, the bridge is in balance and no signal is obtained.

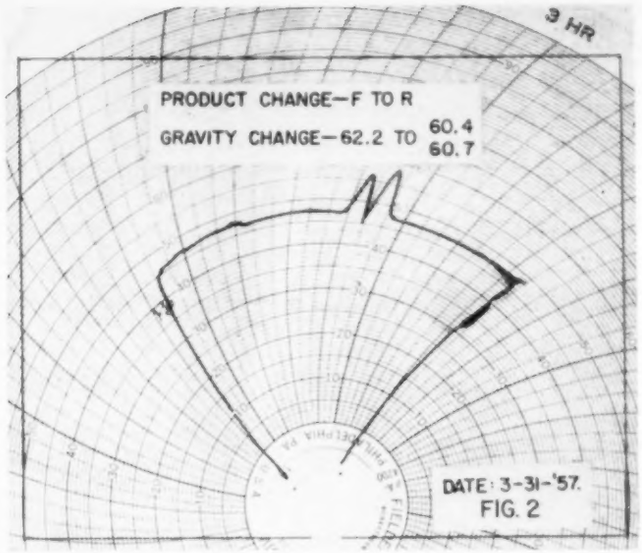


FIGURE 2—With the identical cylindrical condensers, as an interface arrives, the bridge is thrown off balance with a resulting signal. Sensitivity can be increased by delaying arrival of the new product in the second cell.

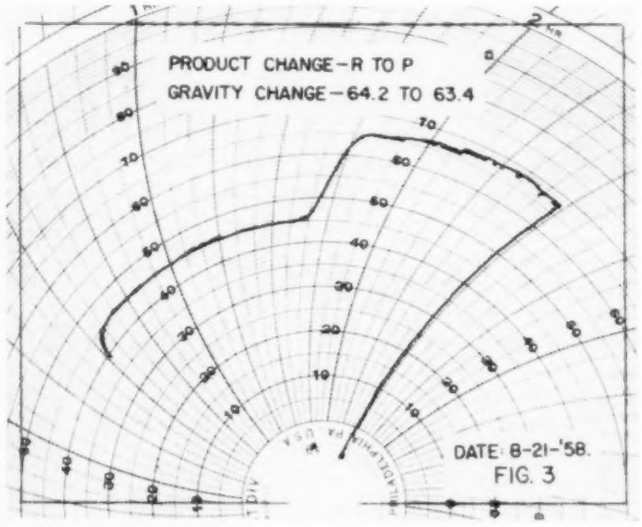


FIGURE 3—In a later adaptation at the Kansas City station one of the cylindrical condensers has been replaced by a fixed condenser with good temperature compensation.

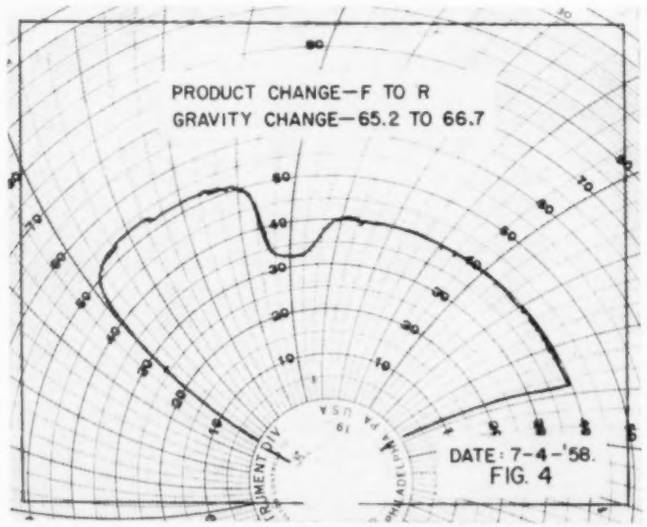


FIGURE 4—Instruments with a fixed condenser are preferred by many station personnel and have the advantage of being usable at lower electrical sensitivity.

relatively easy to detect by different methods and have therefore, concentrated on detection of gasoline—gasoline interfaces.

Since the spread of values for one grade of gasoline overlaps that for other grades, it seems improbable that it will ever be possible to detect 100 percent of the interfaces by measuring a physical property. The probability of detecting a given interface can, however, be computed statistically for any given array of product values if the sensitivity of the detector is known.

Physical Properties Studied. After a preliminary investigation covering a number of physical properties, density, dielectric constant and loss factor, and index of refraction were selected for further study. As a first step these properties were carefully measured for some 50 to 100 samples of each of four grades of gasoline being shipped through Great Lakes lines. On the basis of these results it was concluded that any of the three could be used to build a reasonably successful detection instrument. All showed the characteristic overlap in values mentioned earlier. Treating the data by statistical analysis indicated that measurement of dielectric constant should give a slightly higher probability of detecting an interface than either of the others with instruments of the same sensitivity. Also, it was believed (possibly incorrectly) that this measurement would be the easiest of the three to instrument.

Field Checks Made. Field tests have been made of a gravity recorder and of several capacitance or dielectric recorders. In general the dielectric recorder has shown higher sensitivity but less stability than the gravity recorder.

Two capacitance instruments have been on continuous test on our lines, one at West Tulsa installed in the fall of 1954 and one at Kansas City installed in the spring of 1955. In both instances the detector is located some 2,000 feet upstream from the station with a recorder in the station so that advance warning of the order of 6-8 minutes is obtained.

Distance Traveled Important. The unit at West Tulsa has been quite successful. Station personnel report that they look for a signal on the dielectric indicator before going out to take gravity samples. At this location interfaces have traveled some 35 to 46 miles and give good signals on the recorder.

The second unit was installed at Kansas City in the spring of 1955. Here the interfaces have traveled from Barnsdall, 203 miles, or Tulsa, 237 miles, and are quite diffuse giving much less definite signals on the detector. A great deal of time has been spent in an attempt to obtain the necessary sensitivity and also retain stable operation.

New Design Has Increased Sensitivity. In its final form, the device is an entirely new instrument having a straight capacitance bridge with identical cylindrical condensers through which product flows forming two arms of the bridge. With the same product in both condensers the bridge is in balance and no signal is obtained. As an interface arrives the bridge is thrown off balance

with a resulting signal. Sensitivity can be increased by delaying arrival of the new product in the second cell. Figures 1 and 2 show typical signals obtained with this arrangement.

In a later adaptation at the Kansas City station one of the cylindrical condensers has been replaced by a fixed condenser with good temperature compensation. Figures 3 and 4 show typical signals obtained with this system. This is preferred by many of our station personnel and has the advantage of being usable at lower electrical sensitivity.

Limitations of Dielectric Detectors. Fundamentally the dielectric method, or measurement of any physical property, suffers from three difficulties:

- Noise caused by electrical instability or by passage or deposit of foreign materials in the line.
- The impossibility of detecting 100 percent of the interfaces because of the overlapping of values.
- The necessity of interpreting the sometimes complicated signal before determining the point at which to make a cut.

The first difficulty has been very greatly reduced by careful balancing of electrical components, regulation of voltages and coating of the exposed surfaces of the cylindrical condensers with an insulating material. Occasional flushing of the condensers with only infrequent disassembly for cleaning seems to keep the equipment in good condition. At the West Tulsa station cleaning of the condensers is seldom required (largely because of the relatively low sensitivity required). At Kansas City the unit has been operated as long as five months before cleaning was necessary.

With the second difficulty, it is expected that if we should adopt this system, the dielectric difference between the two products bounding an interface would be measured before shipment with a simple dielectric bridge. In case the difference appeared too small, a suitable flag could be injected. Also, it is proposed to install another detector possibly 50 to 100 miles upstream from the receiving point to obtain early information as to the size and shape of the signal. Sensitivity of the final detector could be adjusted accordingly. With this arrangement it is believed something less than 5 per cent of the gasoline interfaces would require flagging. All interfaces involving fuel oils should be readily detected at a low sensitivity setting.

As to the third point, an operator, possibly remote, knowing the line fill which might be involved would decide the time of the product switch. If desired this could be readily adapted to push-button operation of distant valves.

Using Physical Properties Advantageous. Measurement of a physical property, however, does have the advantage of not requiring injection of a flagging material with the accompanying possibility of error. It also enables the operator to follow the exact course of the interface even if a complicated line fill is involved. In addition, a bonus is present in that the record shows clearly the action of the valves involved in the introduction of a new product into the line and highlights any faulty or defective operation.

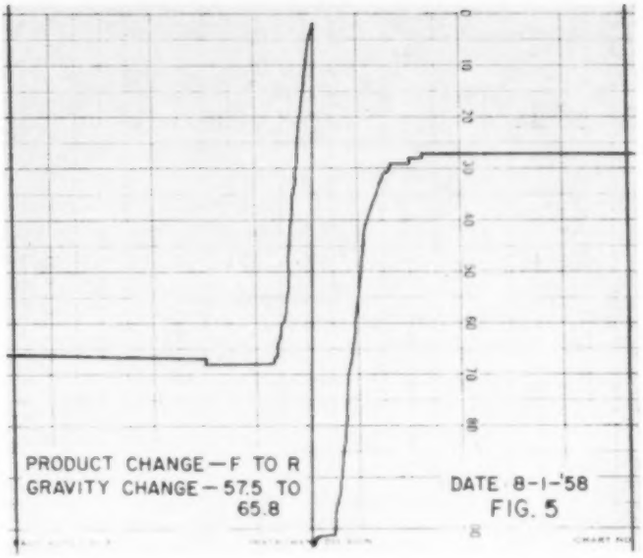


FIGURE 5—In another approach the resonant frequencies of two circuits are compared. One circuit oscillates at a fixed frequency, the other contains a cylindrical condenser through which product is flowing. It has a very high sensitivity and appears to have good stability.

Other Methods Being Tested. In another recent approach the resonant frequencies of two circuits are compared. One circuit oscillates at a fixed frequency, the other contains a cylindrical condenser through which product is flowing. This is now on test with good results. It is a very high sensitivity and so far appears to have good stability. The method of operation permits several excursions of the recording pen across a 5-inch strip chart. When the pen reaches the top of the chart the pen is very rapidly dropped to the bottom of the chart where it starts another excursion. Figure 5 shows a typical signal from this device with return of the pen to the bottom of the chart.

In order ultimately to enable the company to select the type of interface detector best adapted to our system we are also at the present time investigating the use of a new flagging material in a method providing for automatic injection and detection of the flag.

By C. V. Baxter
Salt Lake Pipe Line Company
Salt Lake City, Utah

"Use of radioactive isotopes was adopted to more precisely determine interface position. Radiation problems have been safely handled"

Salt Lake Pipe Line Company since 1950 has used a radioactive isotope to mark interfaces between products in its 713-mile system between Salt Lake and Spokane, Wash. This method was adopted to determine more precisely interface position, particularly at final delivery points, and minimize the blending or disposition problem inherent with products pipe line operation. Since this pipe line does not operate on the common stream

principle but identifies each shipper's products, this more precise method was deemed essential.

Properties of Tracer. A radioactive tracer for this application must meet several requirements. It must emit strong gamma rays which can penetrate the walls of the pipe. Its half life must be long enough to enable its detection after many days in the pipe line, but short enough to be self-destroying in a reasonably short time. It must be capable of preparation into a stable, oil soluble, water insoluble compound. A material which meets these specifications to an unusual degree is antimony 123 which has a half life of 60 days and emits both beta and gamma rays. The amount of radioactive tracer employed is about 2 millicuries, and in solution is equivalent to 1 cc.

Detection Equipment. The radiation detection equipment at the various take-off points and at the terminus of the line consists of a bundle of gamma ray sensitive Geiger-Mueller tubes strapped to the pipe. Output of these Geiger tubes is fed into a counting rate meter which is connected to an appropriate recorder. The Geiger tubes and rate meter which is connected to an appropriate recorder. The Geiger tubes and rate meter are continuously observing a "background" count rate due to cosmic rays and natural radioactivity in the ground. This background count may be suppressed in the recording instruments so that a record is made only of the additional radiation observed when the interface passes the counters.

Interface Tagged. When the radioactive tracer is first injected at the interface between two liquids, the counters show its passage as a wave of high intensity, but short duration. The tracer diffuses with the commingling products as the interface develops in volume in its passage through the line and the counters record a broader wave of smaller amplitude. The shape of the radioactive wave can be expressed mathematically and has been found to fit the normal probability curve. The peak height of the tracer wave, which is a function of the amount of tracer injected, is observed to decrease approximately as the square root of the distance traveled; while the width of the wave, which is a measure of the volume of intermixing, is observed also to increase approximately as the square root of the distance. The total number of counts recorded at any station is constant under standardized conditions of flow and measurement.

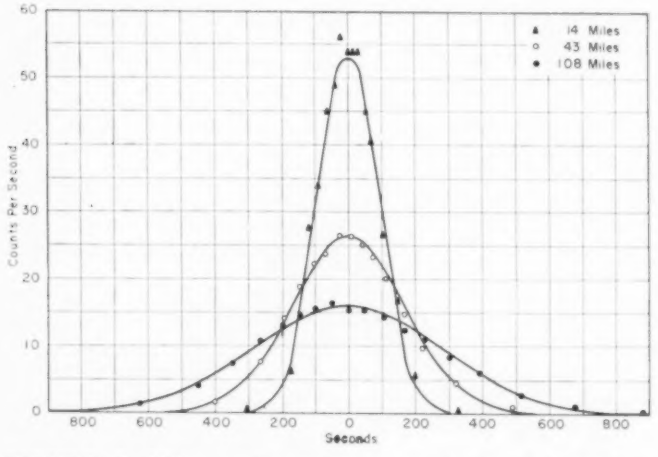


FIGURE 6—When radioactive tracer is first injected, the counters show its passage as a wave of high intensity; but short duration. The tracer diffuses with the commingling products as the interface develops in volume and the counters record a broader wave of smaller amplitude.

Radioactivity, and hence the concentration of tracer at any point in a developed interface, is a measure of the amount of product intermixture at that point. Therefore, the amount of mixing of one component into the other can be determined at any point and breaks between tenders can be made with any desired limit of contamination.

Rate of Flow Affects Interface. These observations can be interpreted on the basis of turbulent flow within the pipe line. Under normal conditions of turbulent flow the interface spreads symetrically in both directions. Under conditions of viscous flow, as found with reduced pumping speed, the interface is extended on the trailing side and the shape and concentration relationships are different.

In operation, as the leading edge of an interface arrives at a station, the radiation level begins to rise. A peak is reached when the center of the interface or point of greater commingling between products is passing. As the interface passes the level subsides. Thus, it is easy for an operator to determine the "first break" or point where commingling begins, the "peak" or point or equal product mixture and the "last break" where the interface ends and a pure product is flowing in the line.

Precise Cuts Possible. At intermediate stations where only "heart cuts" are made from the line, the tracer is used to indicate the passage of the interface and to permit the operator to withdraw only pure product between interfaces.

At the terminus of the line and at two intermediate stations, the operator must switch products at the interfaces. At these stations, the operation has been simplified by installing a ratemeter several miles upstream. The output of this meter is telemetered to the adjacent delivery station where it is recorded, giving the operator an advance picture of the approaching interface and a knowledge of the peak counting rate corresponding to the center of the interface. With this information, he can cut the product at some predetermined percentage of the peak counting rate corresponding to the allowable degree of contamination of products. That portion of the interface which involves extensive intermixing of products is diverted as a "slop cut". With radioactive marking, the loss of products in the "slop cut" is minimized.

Radiological Safety. Aside from the laboratory where the tracer is prepared and the injection station, both of which are adequately designed for radiation protection, no other radiological precautions are required. Once injected into the pipe line, the tracer is greatly diluted, so that no further hazard is associated with the passage of the tracer wave. In the storage tanks at the terminal, where the interface is diverted, there is further dilution. In fact, total body immersion in the oil would result in less exposure than that due to cosmic rays. Finally, the radiation level decreases constantly as a result of radioactive decay. The radiation problems associated with interface marking in the products pipe line have been handled successfully.

By W. W. Holt, Jr.
Plantation Pipe Line Company
Atlanta, Ga.

"Laboratory tests of an instrument which indicates the difference in refractive indexes of different products have been most encouraging"

THE PERFORMANCE requirements of interface detectors on the Plantation pipe line are most severe. With a far-flung system totaling 2,377 miles of main line and lateral lines, an input capacity of 305,000 barrels per day, 18 shippers with 60 different products, 3 input points and 18 delivery points, scheduling of throughput becomes a very complicated problem.

Operation of the system requires the use of every reliable mechanical, electrical and instrumental aid in order to maintain maximum economic flow rates, accurately measure liquid volumes and deliver the product to the correct shipper.

Interface Determined Manually. The need for an instrument that will be accurate and completely dependable in determining batch interfaces is obvious. Such an instrument would greatly facilitate the handling of so very many segregated products. Operationally, interface detection is accomplished manually. Normally, gravity is measured with hydrometers, but when the gravity of the two products is close, color is used. For color detection, a blue dye is injected and spreads with the interface.

This method is also used when two gasolines have the same color. Since these methods are performed by personnel, human errors are involved and mistakes have been made—some have been costly because the pipe line is responsible while the product is in its custody.

Gravitometers Lack Sensitivity. During the past eight years, Plantation has been seeking a batch interface detection instrument. Continuous recording gravitometers are installed at all pumping stations and terminals. These have been a great help in tracking interfaces for dispatching purposes, but this has been the extent of their use. They are not considered sufficiently reliable for use in cutting batches. Although they are pressure compensated, sharp changes in pressure give an indication very similar to a batch change. As specific gravity changes approach ± 0.005, the instrument is unreliable.

Rouge Causes False Readings. The dielectric property of petroleum has been considered by many in the industry as a reliable indication of a particular batch. Three different capacitance type instruments have been tested on the Plantation system. Some of these, at first, showed promise, but with extended testing either became insensitive or were unreliable. It was found that a small deposit of iron rouge, 1-5 microns in size, rendered the capacitance probe insensitive to dielectric changes. Filters proved to be inadequate to overcome this difficulty. It was also impossible to determine when this rouge accumulation would occur and render the indicating instrument inoperative.

Also, during the tests with the capacitance type detectors, it was discovered that entirely different type products could give identical dielectric indications. The most unusual was one batch of kerosine and a premium gasoline indicated the same capacitance. Dissolved water and free-water also imposed a possible error with this type instrument. All components of this instrument were reliable except the probe or cell.

Other Properties Studied. Another property, color, has been investigated without any great success. Colorimeters are delicate and the one tested proved unsatisfactory for field work. Blue dye plugs were successfully tracked at six stations located along 450 miles of 18-inch pipe line. It was established that the color spread very closely matches the gravity spread. The sensing of color differences in batches is not reliable because dirt and water also produce color change indications. Further tests of colorimeters have been abandoned.

Some work has been attempted with the recording viscosimeter. It is possible to detect the difference between gasolines and fuels with this instrument, but distinguishing between gasolines is impossible, because their viscosities all fall within a very narrow band. This property of petroleum is unreliable for batch detection.

Flash point indicators have been investigated and one such instrument tested. This was of the laboratory type and could not be permanently installed. This instrument was very satisfactory in determining safe kerosine from an interface of gasoline and kerosine. It is possible to use it at both ends of a kerosine batch and safely "cut" good kerosine. Since these instruments are expensive and continuous flash samplers have an inherent time lag, their installation could not be justified.

The injection of and subsequent detection of radio active tracers have been considered by Plantation, but thus far no actual tests have been conducted. Management prefers that the detection of a property of the petroleum is preferred to the detection of radioactive materials. The measurement of radiation absorption by different products is also included in this preference.

Refractive Index Promising. Recently, Plantation has conducted laboratory tests of an instrument which indicates the difference in refractive indexes of different products. Sample batches of gasoline having the same gravity were readily distinguishable. Wet kerosine, 2 percent water by volume, gave the same indication as dry kerosine. The addition of dye in far greater concentration than possible in the pipe line, did not affect the reading. 0.1 percent by volume of gasoline in kerosine could be detected. These laboratory results have been most encouraging and Plantation plans to conduct field tests of this instrument in the immediate future.

In conclusion, Plantation desires an instrument that will, without question, detect product interface. No instrument thus far tested has demonstrated the required reliability imposed by this company for its complex operation. In the foreseeable future, there will be requirements for remotely controlled automatic terminals at which custody transfer will occur without local personnel attention. If this type terminal is to be realized a suitable batch interface instrument must have been thoroughly tested and proven prior to the initial design.

—The End

New German Magnetic Girdle Makes Automatic Field Welds Practical

Snapped over the joint like a giant caterpillar, it holds the rod in the bevel and controls weld progress by electromagnetic force. More than 20 miles of 8 to 12-inch utility lines have been field welded in Germany using the new system

By Melvin A. Judah
Editor, PIPE LINE INDUSTRY

IF THE INVENTIVE genius of a German scientist plus three years field experience with a new automatic welding system on European utility lines meets U. S. contractors' requirements for cross country pipe laying, it may be a giant step forward in faster, uniformly high quality welds. Recent shop demonstrations in Houston give good reason to believe that the magnetic welding girdle can eliminate many of the adverse effects of field weather conditions, welder fatigue and differences in individual skills . . . in short, it may change field welding from an art to a reproducible scientific process.

Simple in principle, the automatic welding method uses a belt tabbed the "magnetic girdle" by its inventor; the girdle holds the rod in position and controls the arc and directs flow of molten metal by means of a magnetic field. While the girdle holds the rod in the bevel and molten metal flows into the joint, the weld progresses downhill in much the same manner as

FIGURE 1—Welder strikes arc as semi-circular pass is run on 10-inch joints of pipe at a recent demonstration of German automatic welding equipment in Houston. Magnetic girdles of this type have been used to field weld 20 miles of 8 to 12-inch utility lines in Europe in the last three years. Arc proceeds downhill as magnetic field acts on molten metal flow.

FIGURE 2—Specially designed external line-up clamp fits around pipe on both sides of magnetic girdle. Rod with a high cellulose flux is used for the stringer bead; current setting for the stringer bead is normally between 110 and 130 amperes.

FIGURE 3—Rod is pre-bent over wheel on welding machine and fitted around joint in preparation for filler pass. Each pass is staggered a few inches at 12 and 6 o'clock to eliminate possibility of windowing.

in conventional manual welding. Proper gap is maintained by flux decomposition rate and control of the welding current.

Weld current and field current for the girdle is supplied by a single phase, 15 KVA, 400-volt generator driven at 3,000 rpm; A.C. welding circuit power is 100 volts on open circuit at 100 cycles per second. A three phase, 5 KVA auxiliary generator supplies 50 cycle A.C. at 380 volts for the ventilating blowers, bevelling machine, grinders and other electric hand tools.

How the Girdle Works. The heart of the magnetic welding system is the intricately designed girdle that holds the rod in position. Its segments are linked together so that it looks like a giant caterpillar gripped over the joint.

A segmented back-up piece holds the rod in the bevel and assures the correct gap for the pole shoes of the electromagnet cores (see Figure 4). The outer elements of the girdle are a series of electromagnet coils held in place by a mechanical linkage and protected from damage by an outer

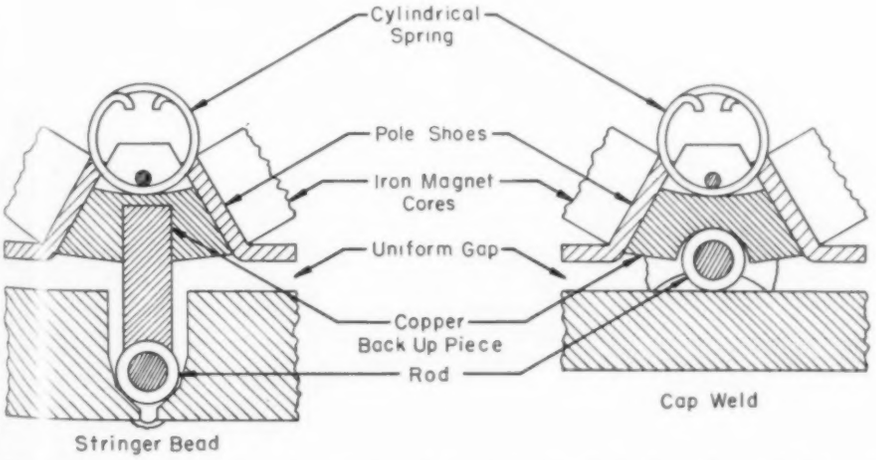


FIGURE 4—Sectional view of a segment of the magnetic girdle shows how welding rod is supported in bevel by copper back-up piece. Magnetic field generated by coil acts through iron core and pole shoes to direct flow of molten metal as the weld progresses. Height of back-up piece is reduced from that shown for the stringer bead on the left to a "countersunk" segment for the cap weld at right.

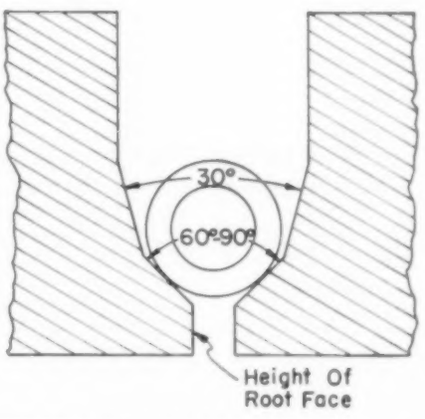


FIGURE 5—A double angled bevel was used on German utility line field welds. Near the root face, bevel was 60 to 90 degrees; 30 degree bevel was used for about the next one-third of the wall thickness. Bevelling machine is powered by welding machine's auxiliary generator.

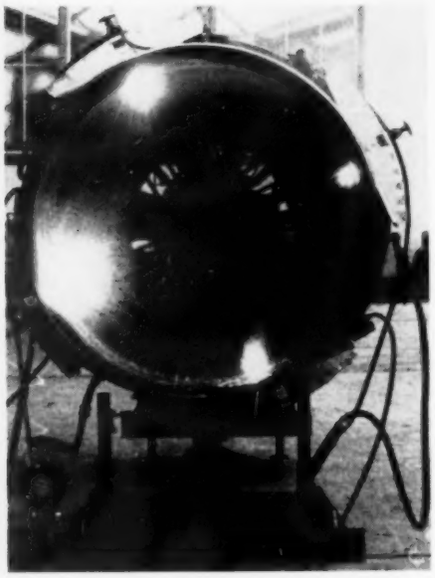


FIGURE 6—Four belts complete stringer bead simultaneously on 28-inch pipe at German yard. Internal line-up clamp, with retractable feeler shims drawn in, may be seen inside pipe. Girdle length may be extended to 22 magnetic coil elements, however, for practical reasons, most girdles have been between 12 and 17 elements.

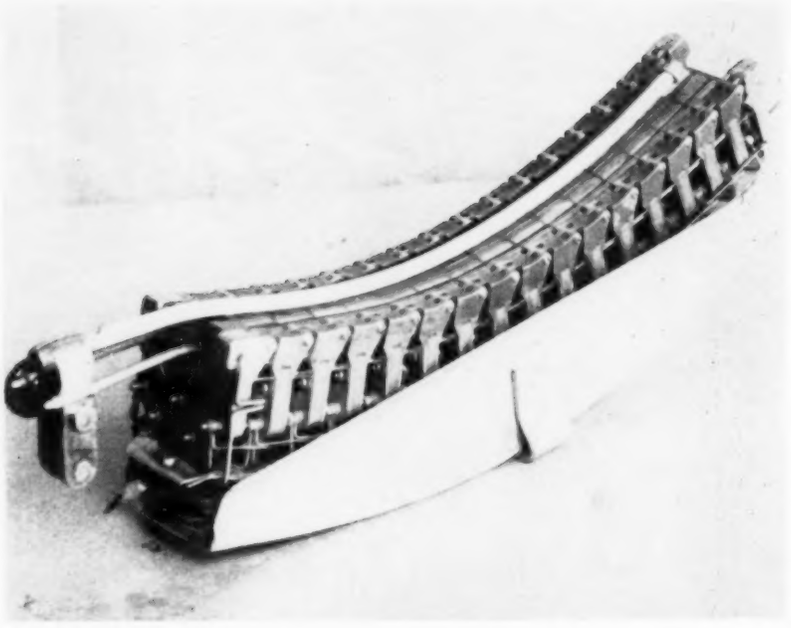


FIGURE 7—On larger diameter pipe, rods are fitted into the contact grips on the end of the belts instead of being bent and fitted around the pipe joint. When strapped onto the pipe, the girdle holds the rod securely in place and the magnetic field acts to direct the molten metal into the joint. Proper gap is maintained by the flux decomposition rate and control of the welding current.

spring wire guard harness. Rod contacts on each end of the belt and a spring loaded fastening buckle complete the belt assembly.

Practically, belt length is limited to 22 magnetic elements; belts used in field welds so far have had from 12 to 17 elements.

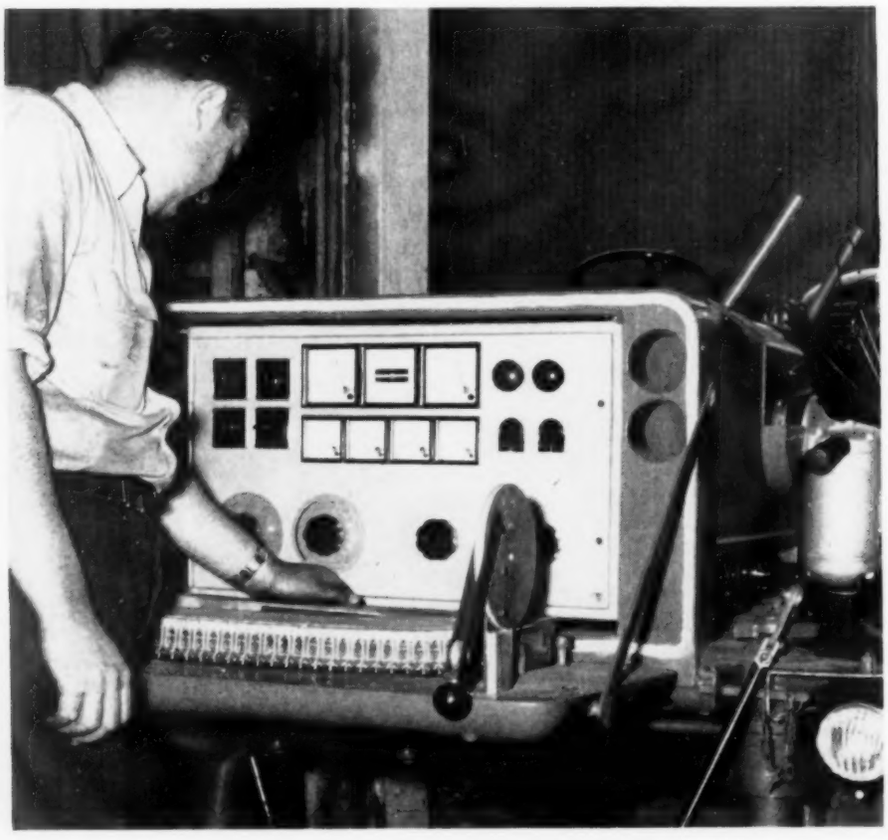


FIGURE 8—Operator sets current controls on welding machine as pass is run. Power to the rod circuit is supplied by a single phase, 15 KVA, 400 volt, 100 cycle generator driven at 3,000 rpm. A three phase auxiliary generator supplies power for the ventilating blowers, bevelling machine and hand tools. Cylindrically shaped compartments, to right above panel, are forced draft "pits" that cool girdles between passes.

Two Angle Bevel Used. Pipe ends are bevelled in much the same manner as with conventional American methods; however, automatic field welds on the German utility lines were made with a double angled bevel. An angle of 60 to 90 degrees was used near the flat root face and a 30 degree angle was used for the rest of the bevel, as shown in Figure 5.

To make the weld, the rod may either be bent and slipped around the pipe joint, or for larger diameter pipe, set into the holder contacts of the belt before it is snapped over the joint. In either case it makes a direct pressure contact with the welding current connectors of the belt; the flux coating insulates the rod itself from the metal joint.

After the belt is snapped onto the pipe and the power settings made on the welding machine control panel, the welder shorts out the rod to the pipe to strike the arc. As the weld progresses down the joint all of the rod is consumed. All field welding on German utility lines using the belt has been downhill.

Especially designed line-up clamps are used with the magnetic belt to control precisely the root face gap. An internal clamp has retractable

"feeler" shims which provide a proper gap during first section of stringer bead. These work independently of the hydraulic jacks that line-up pipe walls; shims are normally retracted after the stringer bead is run.

Several Belts Used at Once. As in conventional welding two or more passes are required for each weld. For pipe smaller than 10-inch, one belt is used on each side of the pipe and shifted to the other side as each pass is completed. To speed up welding on larger diameter pipe, two belts weld simultaneously on 12 to 16-inch; three belts on 18 to 24-inch; and four belts work at one time on 26-inch and up.

Ordinarily it requires about one minute per pass for each belt in actual welding time. Flux is cleaned from the weld with a wire brush, and each end of the weld is ground between passes. Each filler pass is staggered to eliminate the possibility of "windowing."

For longer magnetic girdle life and better control of weld quality, girdles are alternated with spares; between passes the belts are cooled in forced draft pits on the machine. No helpers are needed for normal field welding.

Special Rods Used. Although similar to standard rods, the 4 mm diameter rods used with the magnetic system are specially designed. A high cellulose flux rod is used for the stringer bead. Welding current varies from 110-130 amperes for the stringer pass to 160 to 180 range for fillers. Cap welds normally require a 150 to 170 ampere setting depending upon type of rod used.

Small permanent magnet "stick-on" ground contacts having copper cores are used with the belts.

Three Years in the Field. German pipe line builders first used the magnetic welding machine and belts in 1954; patents were granted on the system in Germany in 1952 and in the United States in 1953.

In a little over three years the magnetic welding method has been used on some 20 miles of 8 to 12-inch steam and hot water utility lines in West Germany. Wall thicknesses up to ½-inch have been welded for these utility services carrying pressures up to 600 psi at temperatures to 200° C.

—The End

FIGURE 9—Welded joint of 10-inch after filler pass had been made. Between passes slag was cleaned off the weld area with wire brush or grinder. End of weld pass segment was ground down to a smooth, bright finish after each pass.

FIGURE 10—Earl Allen, contractor who sponsored the demonstration at Crutcher-Rolf-Cummings' Houston plant and Dr. Hans Gunther, German inventor of the automatic welding system, discuss the design features of the magnetic girdle. Already used in Germany to lay over 20 miles of utility lines in the past three years, the Houston shop demonstration was its first application in American pipe line welding.

Arapahoe LACT Unit Sets Record Transfer

In first three months of operation, unit successfully transfers 743,058 barrels of oil. Skid-mounted units designed for easy maintenance

By John C. Watts
PIPE LINE INDUSTRY Staff

A LARGE part of the increase in oil handled by lease automatic custody transfer during 1958 is the result of one installation. Arapahoe Pipe Line Company received 743,058 barrels through custody transfer metering units from The Pure Oil Company, as operator of the Adena J Sand Unit, Morgan County, Colorado, between April 15 and July 15, 1958. With a capacity of 36,000 barrels per day, this unit alone accounts for more than 20 percent of the capacity reported in a report compiled for the API (See PIPE LINE INDUSTRY, April, 1958, Page 52).

Custody Transfer Unit Skid-Mounted. Three skid-mounted units contain the meters and auxiliary equipment. Each unit has a maximum capacity of 12,000 barrels per day. The units are connected in parallel and one, two, or three units can be placed in operation. Normally two units will be operating with the third serving as a standby.

Two positive displacement meters are connected in series on each unit. Volume is registered by both meters and the readings are fed into a differential combinator which compares the readings and indicates the units of disagreement. If a cumulative difference of 10 barrels within a 24-hour period is indicated, the unit is shutdown automatically, and will remain inoperative until the error is corrected. The first meter contains a ticket printer which prints the run tickets each day. All meters are temperature compensated and read directly in barrels at 60°F.

Auxiliary equipment mounted directly on the meter skid includes, strainers, air eliminator, BS&W monitor, proportional sampler and backpressure valve. A three-way, two-position valve located between the transfer pump and the meter is controlled by the monitor and diverts the

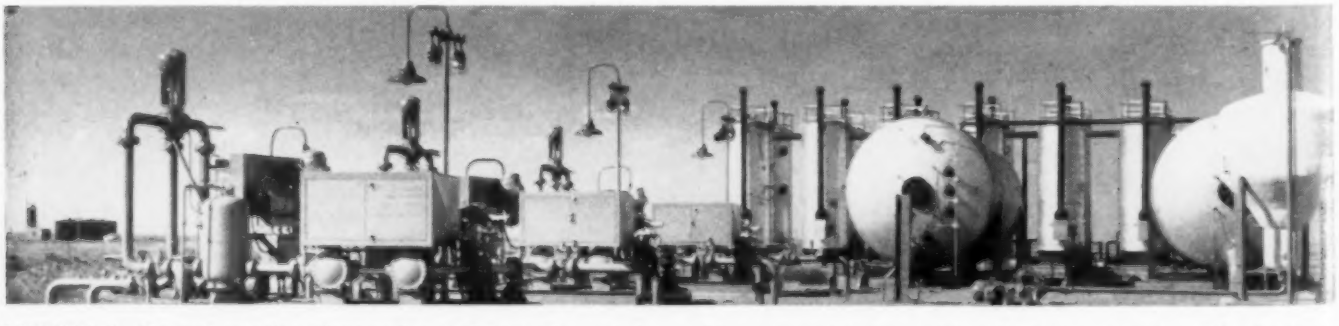


FIGURE 1—Central treating plant and custody transfer unit in Adena field, Colorado, can handle 36,000 barrels of oil per day. Three skid-mounted units contain custody transfer equipment. Measurement is by positive displacement meter. Two horizontal surge tanks, containing level switches, control the flow of oil. These tanks provide the only storage on the lease.

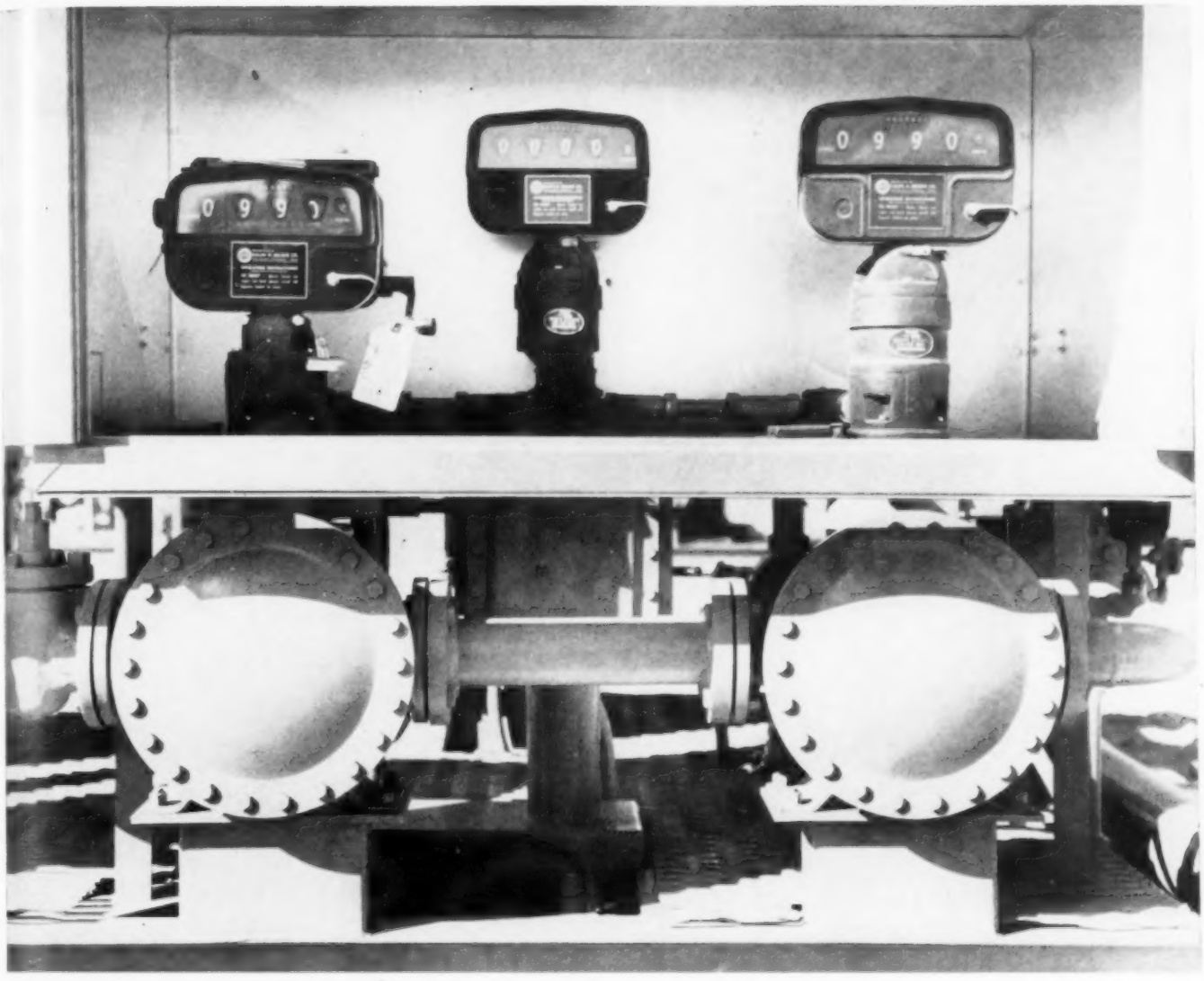


FIGURE 2—Two meters connected in series are located on each skid. Volume is registered by both meters and the readings fed into a differential combinator which compares the readings and indicates the units of disagreement. If a cumulative difference of 10 barrels within a 24-hour period is indicated, the unit is automatically shut down.

oil back to the central treating plant if the oil does not meet pipe line specifications.

Production Transferred to Central Plant. Unitization of the Adena field in 1956 and initiation of a pressure maintenance program in 1957 would have required extensive tank battery relocation. Investigation indicated that a central treating plant and custody transfer station would be the most economical. Individual wells are controlled from stations scattered throughout the field. Oil and water is transferred through the gathering system to the central treaters. The main stem of this system is 5½ miles long and consists of 6-, 8- and 10-inch pipe. Pressure regulating stations at three points are required to overcome a 211-foot drop in elevation.

A maximum flow of 28,500 bpd can be handled by the gathering system. Full line flow was assumed in the design of the system, however excessive pressure drop occurred during operation caused by liberation of solution gas. Installing automatic vents at eight high points along the line and reducing separator pressures eliminated the gas.

Storage Tanks Eliminated. Gathering lines terminate at the central treating station. Clean oil flows from the treater to two horizontal surge

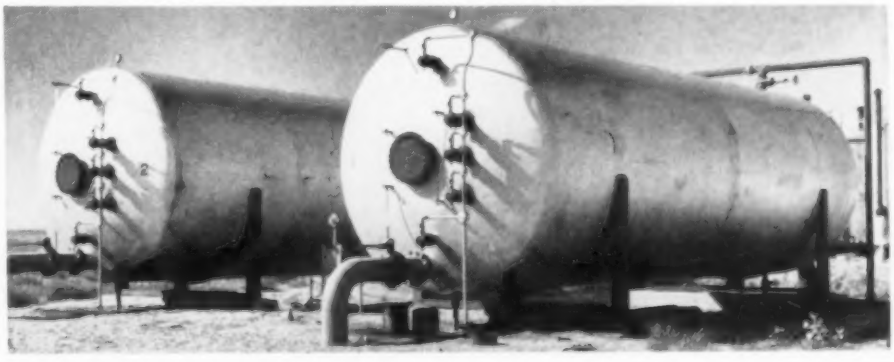


FIGURE 3—Oil is transferred from treaters to two horizontal surge tanks. Oil movement is controlled by five level switches in the tanks. In addition to start and stop operation, two switches control a two-range flow proportioning valve.

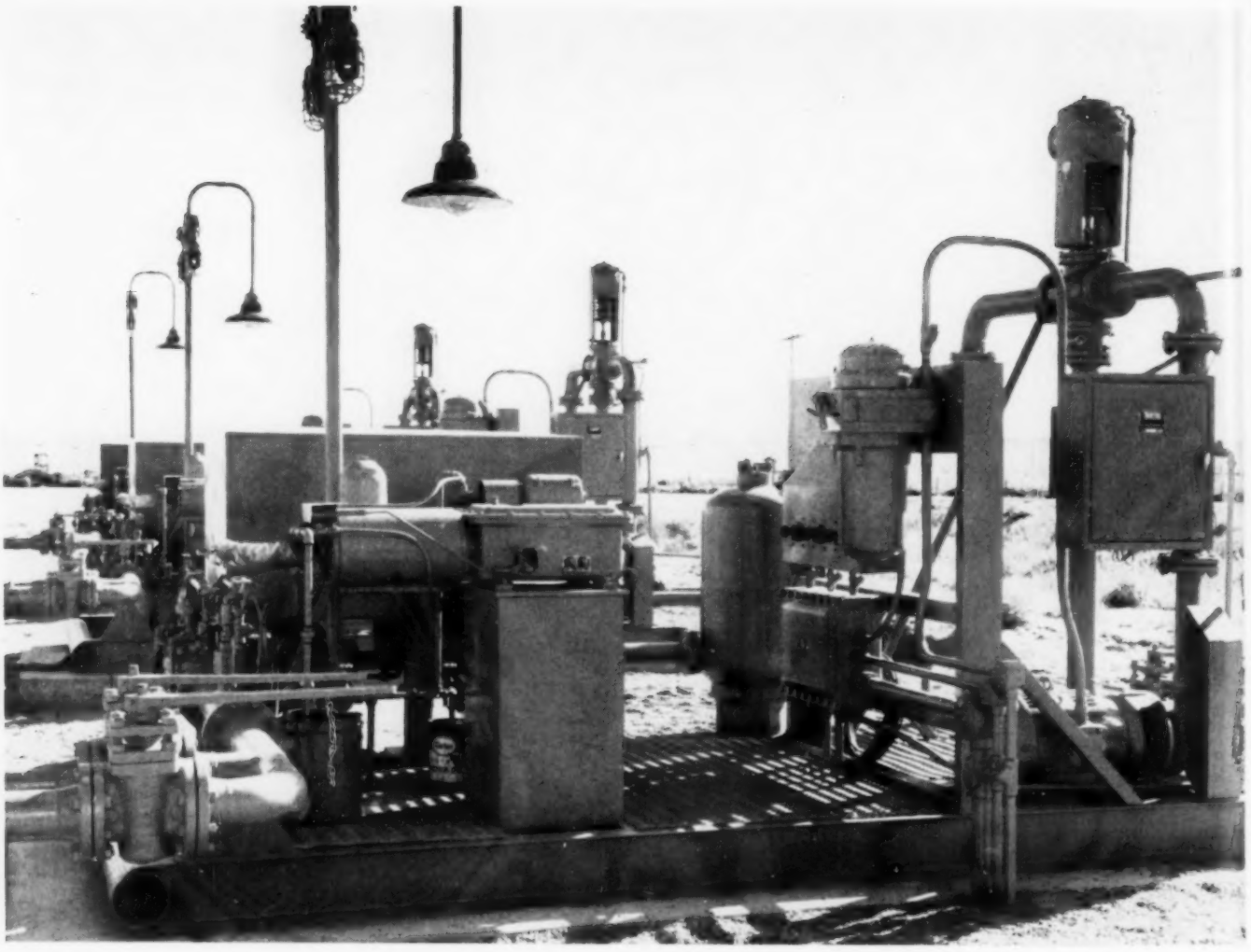


FIGURE 4—Auxiliary equipment mounted on meter skid includes, strainer, air eliminator, BS&W monitor and control valve, proportional sampler, back pressure valve and signal lights for visual indication of unit operation.

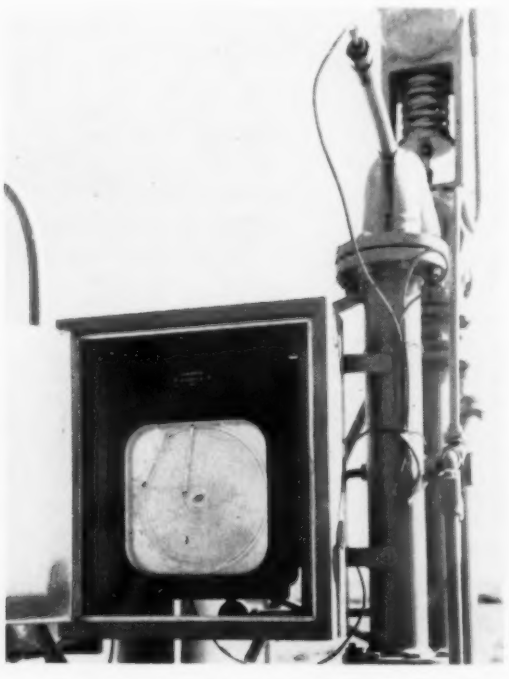


FIGURE 5—A capacitance type BS&W monitor controls a three-way valve which diverts bad oil from the pipe line. The monitor is set for 0.46 percent BS&W.

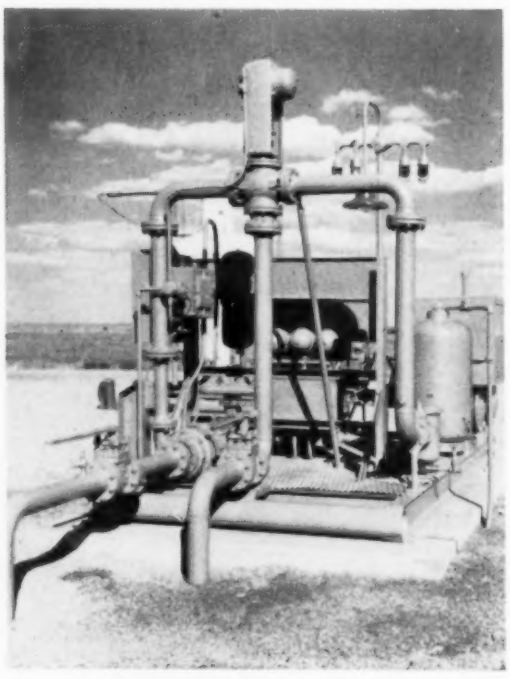


FIGURE 6—A three-way, two position valve is located between the transfer pump and the meter. Controlled by the BS&W monitor, this valve recirculates non-specification oil.

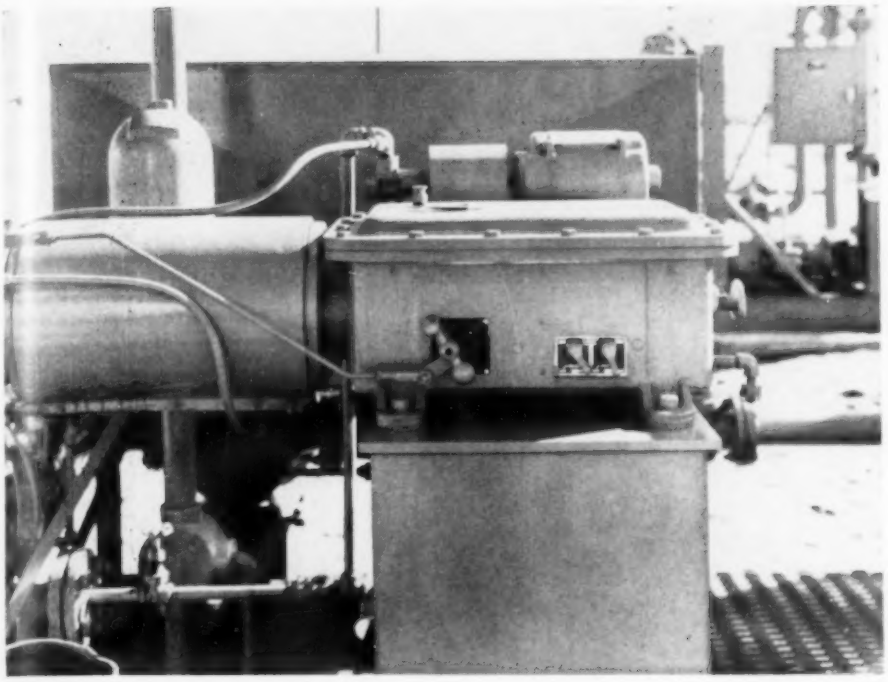


FIGURE 7—A proportional sampler collects a sample of the oil transferred. BS&W and gravity determined from this sample are used to correct the run tickets for net oil purchased.

tanks. These tanks provide the only storage on the lease. A positive pressure is maintained on tanks and treaters to reduce evaporation losses. Measured gravity of the oil received through the custody transfer units has averaged 1.4° API higher than oil received from a stock tank, resulting in an increase in volume of 3½ percent.

Oil movement is controlled by five level switches in the surge tanks. In addition to start and stop operation, two switches control a two-range flow proportioning valve. Located downstream from the meters, this valve maintains a suitable flow rate and a positive back pressure on the meters.

Operation of the level switches is as follows:

- Bottom—shut off, low level
- Second—low flow control, back pressure valve increased to 60 psi when level drops to actuate switch
- Third—start switch, puts units back on line after low level control has shutdown operation
- Fourth—high flow control, reduces back pressure valve to 40 psi, starts standby unit
- Fifth—shut off, high level, shuts in field.

Visual Indication Provided. Colored lights which can be seen from a distance give visual indication of the operation of the unit. Located on a high standard on the end of the skid, operation of the lights is as follows:

- Green—normal operation, oil being transferred to pipe line
- Red—circulating bad oil
- Amber—unit on standby waiting for oil

FIGURE 8—Meters are proved once a week with a seraphin neck prover tank. Because of variations in temperature, the tank was insulated.

- Blue—oil is below low level in surge tanks.

As the unit comes on, it starts on low flow control. If more oil is being produced than is being transferred to the pipe line when the second float is reached the back pressure valve will be shifted to the high flow rate. Low flow rate is 350 bph with high flow at 500 bph. Transfer units will stay at high flow until surge tank level goes down to low flow level.

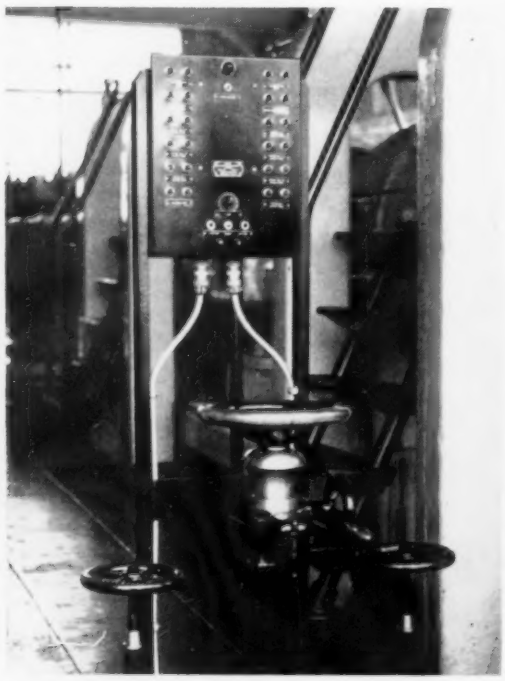
Protection From Bad Oil. A capacitance type BS&W monitor installed on each metering skid controls a three-way valve located between the transfer pump and the meter. Pipe line specifications call for a maximum of 0.5 percent BS&W. The monitor is set for 0.46 percent. During early operation of the unit, paraffin accumulation on the probe caused clean oil to be recirculated. Since this occurred when the level in the surge tanks was low, installing spreaders in the bottom of the tanks and continuous circulation of a small amount of hot oil from the treaters eliminated this faulty indication.

The BS&W monitor is used only to keep bad oil out of the pipe line. Run tickets are calculated using BS&W content and gravity obtained from samples collected by a proportional sampler installed in the metering unit. This sample is collected daily and adjustment made on the meter ticket.

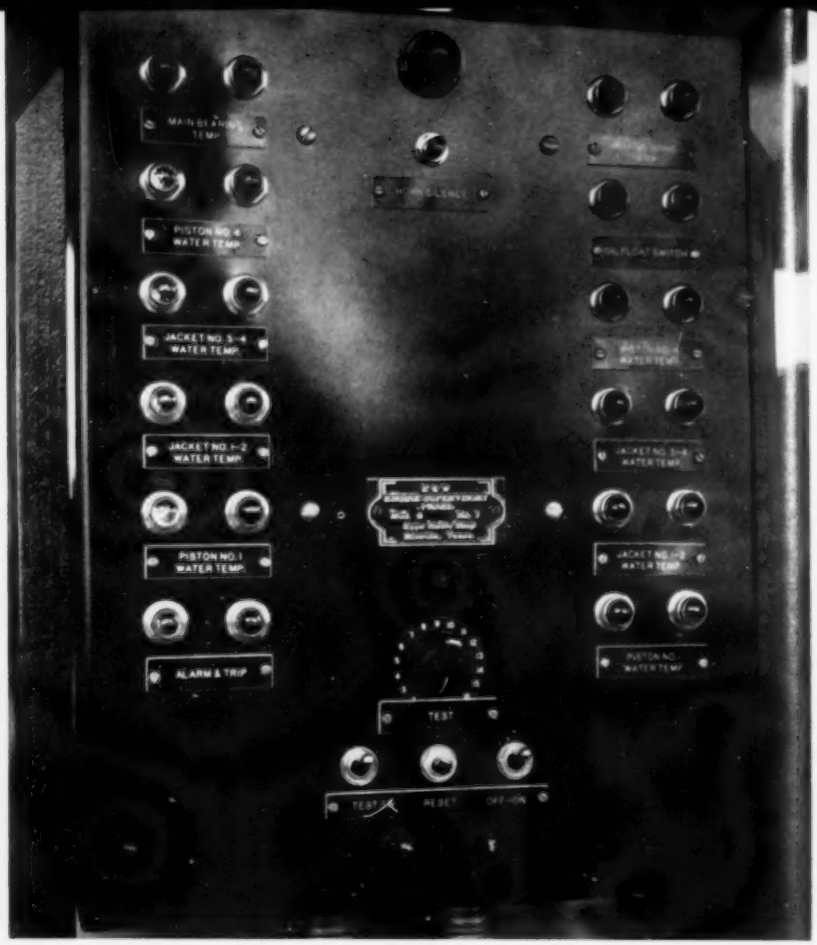
Meter Proving. Meters are proved once a week with a 23.80 barrel seraphin neck prover tank. Initial operation indicated excessive variations in oil temperature which ranged from 110-118° F. Since variations in oil temperature would be greater during the winter, the prover tank was insulated. Two thicknesses of fiber glass covered by canvas and painted prevent temperature loss. A similar insulation is planned for the surge tanks.

Safety Precautions. Pressure switches located at the production stations shut down the stations when excess pressures build up in the gathering system. Production is shut in when the level in the surge tanks reaches the high level switch. In addition to being shut down due to meter error, the custody transfer unit is shut down if there is a power failure.

—**The End**



Supervisory panel installed at United Gas' Mineola, Texas, station is typical of 35 units now monitoring operating conditions on older compressor engines. Panels and component parts are standardized; they may be switched between engines or stations.



Close-up of panel front; 13 sets of green and red indication lights show compressor operating conditions at a glance. Large red warning light above "horn silence" button is visible the full length of the station so that an operator may spot the source of trouble immediately when alarm sounds. Panel circuits may be tested out in a few seconds without interfering with supervisory monitoring.

United Gas Fits Automation to Oldtimers

By Clyde Epps, Epps Radio Shop, Mineola, Texas
C. L. Walters, United Gas Pipe Line Company, Mineola, Texas

IT IS POSSIBLE to gain many of the advantages of automatic control without starting from scratch with a brand new station. In modernization of 35 compressor units, United Gas Pipe Line Company recognized a need for closer operating supervision. Some of these engines had service records extending back 30 years, and many of them are operating at a higher capacity than when first started up.

To do the monitoring, simplified and interchangeable panels were built for each engine. Safety switches check engine cooling water temperature, main bearing temperatures and lubricating oil flow at vital points in the engines.

If a main bearing becomes overheated, the temperature indicating pointer on the safety switch moves upscale. When it reaches the pre-set danger point it makes contact with an electric warning system. A siren sounds the alarm.

On the first temperature rise of a main bearing, the alarm sounds. If the condition is not corrected, an additional temperature rise above set limits will trip the engine out. Alarm and shut-down temperature set points may be made for each main bearing independently; there are two thermocouple switches on each main bearing.

Supervisory panels for all of the compressor units are mounted so that they are visible the full length of the station. Rows of green and red indication lights tell the story on each engine at a glance. If all of the green lights are burning, then the engine is operating normally.

Each board has 12 positions of indication, monitored with a green and red single contact bayonet pilot lamp. An engraved nameplate under each pair of lamps identifies the possible trouble. A large red warning lamp at the top center of the board lights in case of any trouble indication on the board. It is visible from a distance and quickly shows the engine involved when the alarm sounds.

In case trouble does develop on some monitored condition, the green indicating lamp goes out, the red individual condition lamp and large red engine light comes on and the siren sounds. Pressing the silence button cuts out the horn, but leaves

he red indicating light burning. Thus, he board is still protecting the engine while the operator is clearing the trouble. After all troubles have been cleared, the reset button is pressed to clear the board of all red lights.

To achieve this in the simplest manner, an unusual approach was used. The alarm relay remains energized at all times; it remains picked up through a series string of all relays linked up single pole, double throw. Thus, when any relay is energized by a case of trouble the alarm relay will drop out while the points are moving from one contact to the other on the indicating relay.

In this way the alarm relay may be picked up and sealed in again simply by pushing the horn silence button. This method is both very simple and effective.

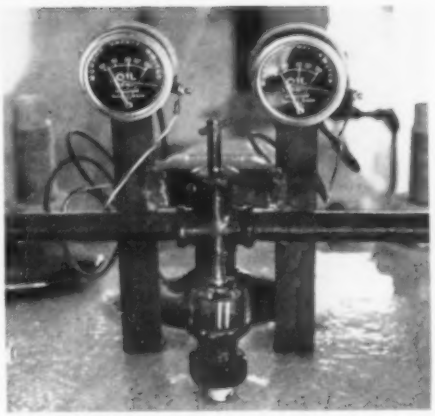
How the Panels Were Built. Safety was the first consideration. Simplicity, ease of maintenance and interchangeability were achieved also in designing the panels. Operating power is 6.3 volts AC. This power rating was chosen because it can be supplied with readily available standard filament transformers of proven reliability and having no shock hazard.

Provision is made for testing all functions of the board at any time. By depressing a spring return switch and then rotating the rotary switch, each relay will pick up, seal in and drop out in regular order. The alarm horn will be silenced during this test while the proper operation of all relays, indicating lamps and circuitry can be determined. There is no danger of tripping the unit during testing.

Both the 110 volt AC feeder line and horn circuit are protected with 2 ampere fuses accessible from the front of the panel. All of the electronic circuitry is enclosed in a standard 13 by 17 by 4-inch steel cabinet.

Design of the panel is based upon the simple operation of double pole, double throw sealed relays equipped with octal bases that plug into standard octal sockets. All relays are identical so that they are interchangeable. The main panel is permanently wired to the sockets; wiring is laced for protection against vibration and damage. In troubleshooting, the panel it is simple to plug in a spare relay or indicator lamp.

All wiring is brought out at the bottom of the cabinet through two 11 contact sockets. Wiring of all



Engine operating conditions monitored by United Gas' supervisory panels include main bearing and cooling water temperatures and lubricating oil flow. Safety switches (top, left) check temperature of main bearing lubricating oil temperatures. When safety switch pointer reaches pre-set point it closes contact on alarm warning system; a further increase in main bearing temperatures will trip the engine out. There are two thermocouple switches on each main bearing. Switch (bottom left) senses piston cooling water temperature. If water temperature reaches upper limit set point, alarm sounds, but engine is not shut down. Float activated switch (right) assures uninterrupted flow of lubricating oil.

panels is identical; they may be interchanged from one engine or station to another by simply plugging in. Use of plug-in parts and plug-in panels enables operating men with limited electrical skills to make replacements or repairs.

Relays require less than 0.5 amperes at 6.3 volts for operation; they are so wired that they will pick up and seal themselves in upon a momentary contact. Thus, a contact may be made but not broken outside of the panel. All contacts must be broken by the reset button which is an approved switch located inside the panel box. This eliminates the possibility of spark hazards.

If wiring outside of the panel becomes severely damaged during engine repair, overhaul or in other ways, it would only cause the horn to sound; no sparks can arc across.

In designing the panels, fancy circuitry and electronic elements were avoided to keep them as simple as possible. This thinking fits in with the operating features of the compressors guarded; it also makes for quick, simple, low-cost maintenance by either trained or untrained station personnel.

—The End

About the Authors

C. W. Epps is retired from United Gas Pipe Line Company after 23 years experience in that company's Compressor Station department. He was formerly chief engineer at the Napoleonville, La., gas turbine station and at the Montpelier, La., station. Since retiring he has devoted much of his time to electronics development and repair work in his specialized shop.

C. L. Walters, first engineer at United Gas Line's Mineola station, has 26 years of compressor station engineering experience. He also has studied in the electronics and electrical fields for the past several years. Development of the supervisory panels for older type compressor engines was in large part the result of the combined efforts of these two experienced station engineers.

PART 1

Today's Trends in the Use Of the Tools of Automation

This broad industry survey reflects the design thinking of leading crude oil and products pipe line engineers and operating management

By E. B. Turner
General Electric Co.
Schenectady, N. Y.

JUST WHERE in the field of automation is the pipe line industry today? To answer this question, a survey was made of 48 crude and products pipe line companies operating approximately 125,000 miles of line. Replies received represent approximately 112,000 miles (or 90 percent) of the total system mileage surveyed. To promote a uniform approach, the degree of use and system combinations of these tools were covered in the survey.

Degrees of Automation Established. To relate results of the survey to the larger consideration of complete pipe line automation, a logical scale was established. Attainment of complete automation is a building block process beginning with the basic equipment in Zone 1 and progressing to the completely automatic computer controlled pipe line in Zone 6 (Figure 1). To overcome any difficulties encountered in an operating zone, the system should be flexible; it should have the ability to revert back to operation in the next lower zone. There should be an accompanying chart indicating the types of skill and degrees of skill required for operation in the different zones.

In the basic zone, physical requirements would be at a peak and the logical ability and training at a minimum. As automation progresses through the zones, physical aspects diminish and the training and logical abilities of the individual increase at a rate comparable to the degree of automation.

Evolution of Automated Pipe Line. To assure continuous operation, the ability to revert to the next lower zone must be built into the system. The man who operates the system must be able to perform to a comparable degree the function of the higher zone which may be temporarily out of service, pointing up the need for highly trained and skilled operators as a part of any automated pipe line.

The block diagram (Figure 2) of the computer controlled pipe line is a functional representation of the equipment required and the interrelationship of this equipment. One master station and one remote station connected by a communications channel is illustrated. For grouped remote control the equipment required is the same with duplication of the remote station facilities.

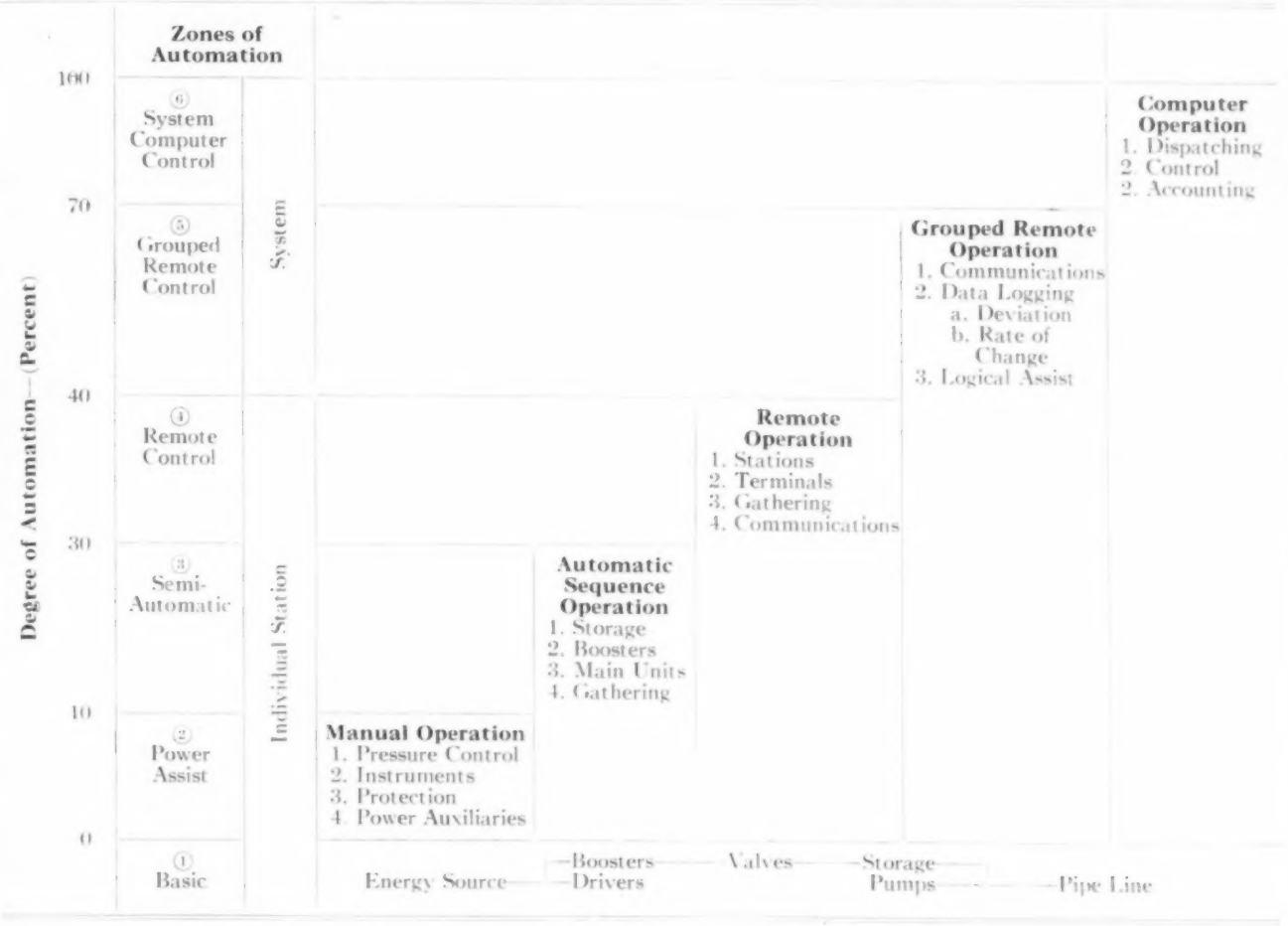
"Building Blocks" Inter-related. In progressing to Zone 6, where the computer is controlling the pipe line, the basic equipment is shown on the right at the remote station and includes everything required for obtaining Zone 2 operation. Zone 3 is obtained by the addition of sequence control and Zone 4 by the addition of supervisory control. At this point the concept of pipe line automation changes from consideration of the individual station to consideration of a pipe line system.

Control of Multiple Stations. Zone 5 is obtained by combining multiple remote stations and a data logging system. Some of the important functional features of data logging which become more important as the number of remote locations increases are:

- Deviation Detection—significant changes initiate print-out of the pertinent information.
- Rate of change—changes which occur at excessive or unusual rates are detected and cause print-out of data permitting operator to take action based on actual line conditions.

Due to the large amount of control, indication and telemetering re-

FIGURE 1—PIPE LINE AUTOMATION



Progressive Zones of Pipe Line Automation

Basic—Zone 1: Basic equipment represented by energy source, pipe line, prime movers and pumps, as well as necessary auxiliary boosters, valves and storage facilities. Zero percent automation.

Power Assist—Zone 2: Manual operation with assistance of pressure control equipment, instrumentation, protection and power auxiliaries. Basic operation still manual, all decision and logical evaluation in normal operation of station performed by operator.

Semi-Automatic—Zone 3: Lesser degree of manual operation since basic equipment is operated with automatic sequence control. Still semi-automatic in operation since operator must select proper operation and start sequence control function. Sequence operation of storage facilities, boosters, main pump units, gathering system components and associated auxiliaries included in this zone.

Remote Control—Zone 4: Operation of station equipment from remote point. Station facilities are extended by addition of communications link between master station and remote station. To remotely operate stations, terminals, or gathering system, the semi-automatic operation as well as power assist of zones 2 and 3 is a prerequisite. Essentially, fourth zone adds the communications link and selective control and indication facilities of remote equipment in addition to remote instrumentation.

Grouped Remote Control—Zone 5: Remote control of a number of remote stations from a central location. Communications link becomes increasingly important because of increasing dependency of total system operation on this equipment. Control of large number of stations from one location requires convenient method of handling pipe line operational data introducing data logging equipment. Among more important functional features of data logging are deviation detection and rate of change. Due to large amount of control, indication, and telemetering information in a grouped remote control master station, the operation of a system at most efficient point requires a memory device capable of logical decision called "Logical Assist."

Computer Control—Zone 6: Continuous operation of pipe line at optimum efficiency obtained by closing control loop of all remote stations with a computer. Computer would function in area of dispatching, control and accounting, forecasting deliveries, availability of crude or products for shipment, insuring minimum storage requirements for given pipe line capacity, formulation of dispatching schedule based on requirements and availability of product or crude and availability of storage facilities at delivery end, implementation of dispatching schedule by computer operation of supervisory control and data logging equipment.

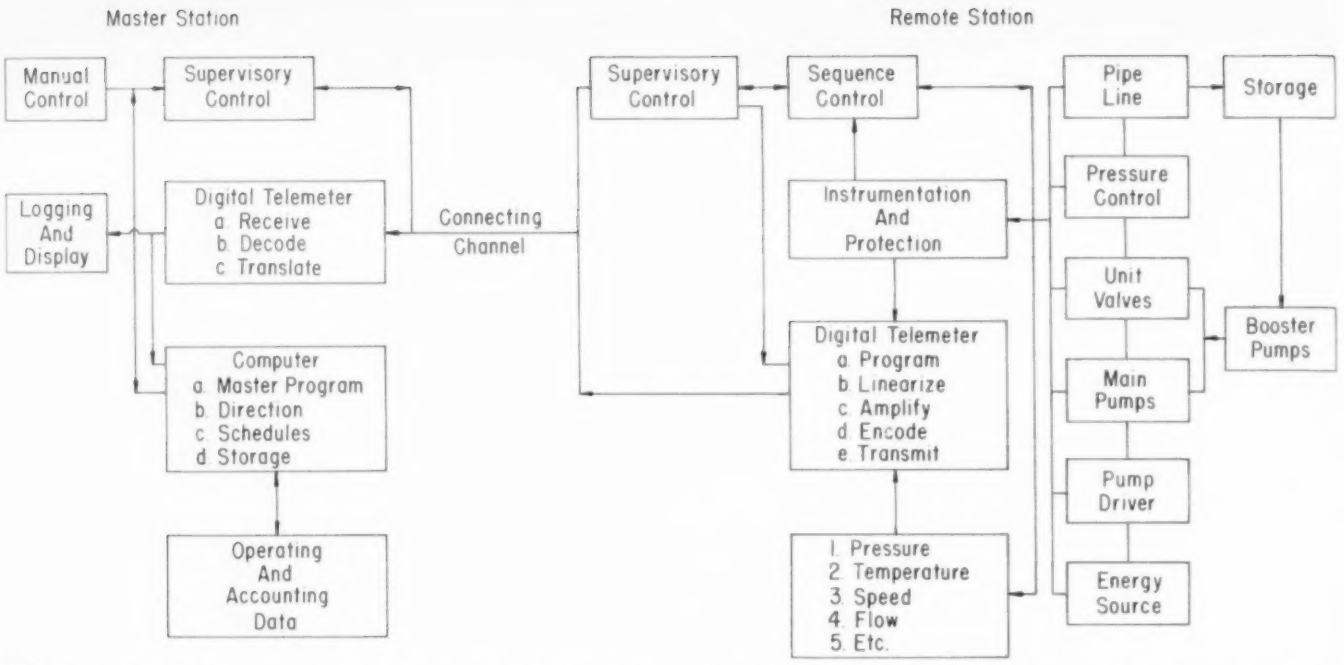


FIGURE 2—Block diagram of computer controlled pipe line. One master and one remote station connected by communications channel is illustrated. For grouped remote control, only duplication of remote station facilities is required.

formation, to operate the system most efficiently the operator should be provided with equipment which is functionally called "logical assist." The logical assist equipment can be considered to be a memory device which is capable of logical decision. Since in this zone of automation the computer would not be tied into the control circuitry or the digital telemeter and logging equipment, the logical assist function could be provided by the computer operated manually by the operator. Furnished information on the desired operating conditions, the equipment would determine the proper operating status of all stations providing typewritten instructions which are then transferred to supervisory control and communications equipment. The logical assist could also be used for solving problems pertaining to maximum permissible flows under various operating conditions or any number of other related operating problems. Among these might be the formulation of dispatching schedules and inventory of shipments.

As illustrated in the block diagram, the operator has available the means for controlling the remote equipment and obtaining indications of its operating condition through the supervisory control function. Telemetering equipment provides the necessary measurements of pressure, temperature, speed, flow and other pertinent data. To change a set of conditions, manual operation of the supervisory equipment energizes the sequence control which performs the required operation at the remote station. Indications of operation are received confirming the performance of instructions. Proper protection and instrumentation provide self-contained monitoring for the remote station. Telemetered information is available over the connecting channel for the operator's interpretation.

Completely Automated Operation. In Zone 6, the computer directs the supervisory control and digital telemeter equipment. Operating and accounting data in its programming and scheduling functions is handled by the computer. Data for the affiliated business functions of the company are also provided. Due to the high degree of dependency placed on this computer, it probably should be a special purpose computer designed for this specific application. Reliability design considerations should be great. Its self-checking and trouble-locating circuitry should be designed for quick isolation of difficulties, as well as ready replacement of malfunctioning parts. The ability to manually perform some of the operations should also be considered in order to provide a high degree of flexibility in the use of the equipment.

Economic Considerations. The desirability of operating the higher automation zones should be dependent upon economic feasibility. Requirements for highly trained and skilled personnel indicate economic justification must come not in personnel areas, but in the optimizations of operating conditions, savings in investment resulting from minimum storage, maximum throughput and the ability to mechanize those repetitive operations associated with scheduling, dispatching and accounting functions.

How the Survey Was Made. In the survey, the "tools of automation" were broken down into six sections:

1. Protection Equipment
2. Pressure Regulating Equipment
3. Automatic Sequence Control
4. Unattended Station Operation
5. Operation of Multiple Remote Stations from one Master Control Station
6. Computer Usage

An attempt was made to show the equipment now in use and the possible future trends. The degree of

More reliable, less expensive protection equipment needed

use and system combinations of these tools is described by the survey.

PROTECTION EQUIPMENT TRENDS

Equipment used to protect station equipment in the event of abnormal conditions is covered by this section. The survey is intended to cover the more common types of primary sensors or transducers used for quantities of pressure, temperature, and flow. These were divided into three major types:

1 Electrical

2 Mechanical

3 Pneumatic

A protective device was defined as "equipment which operates to shut down or alarm, or actuates a shutdown or alarm circuit." Therefore, the distinction between the electrical, mechanical and pneumatic protection equipment was that the action to shut down or alarm was actuated by an electrical, mechanical or pneumatic signal.

Figure 3 indicates greater use of electrical protective devices than mechanical or pneumatic. This does not necessarily mean that there are more electrical protective devices in operation than mechanical or pneumatic, but it does mean that a large percentage of users have been trying the electrical type.

Figure 3 indicates a trend toward greater use of the electrical devices and declining of both the mechanical and pneumatic.

Equipment Needs. In this category, the following items were indicated (some may not be readily available):

- Flow sensor
- Seal leakage detector
- Liquid level detector (in the presence of microballoons)
- Gravitometer
- Scraper detector
- Over-range protective devices for low range suction pressure transmitters
- A compatible measuring and transmitting system combining measurement, control, protection, indication, and telemetering
- Vibration detector

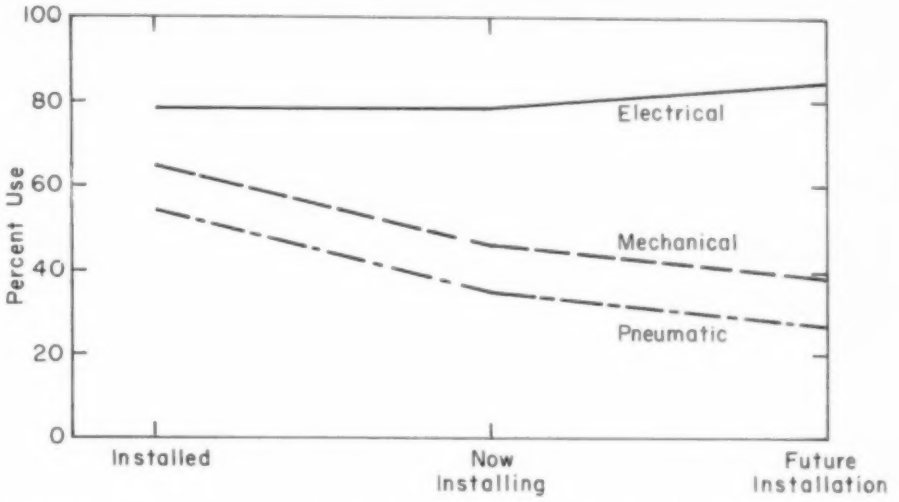


FIGURE 3—Types of protection equipment in use and predicted. Distinction between the electrical, mechanical and pneumatic protection—action to shut down or alarm is actuated by an electrical, mechanical or pneumatic signal.

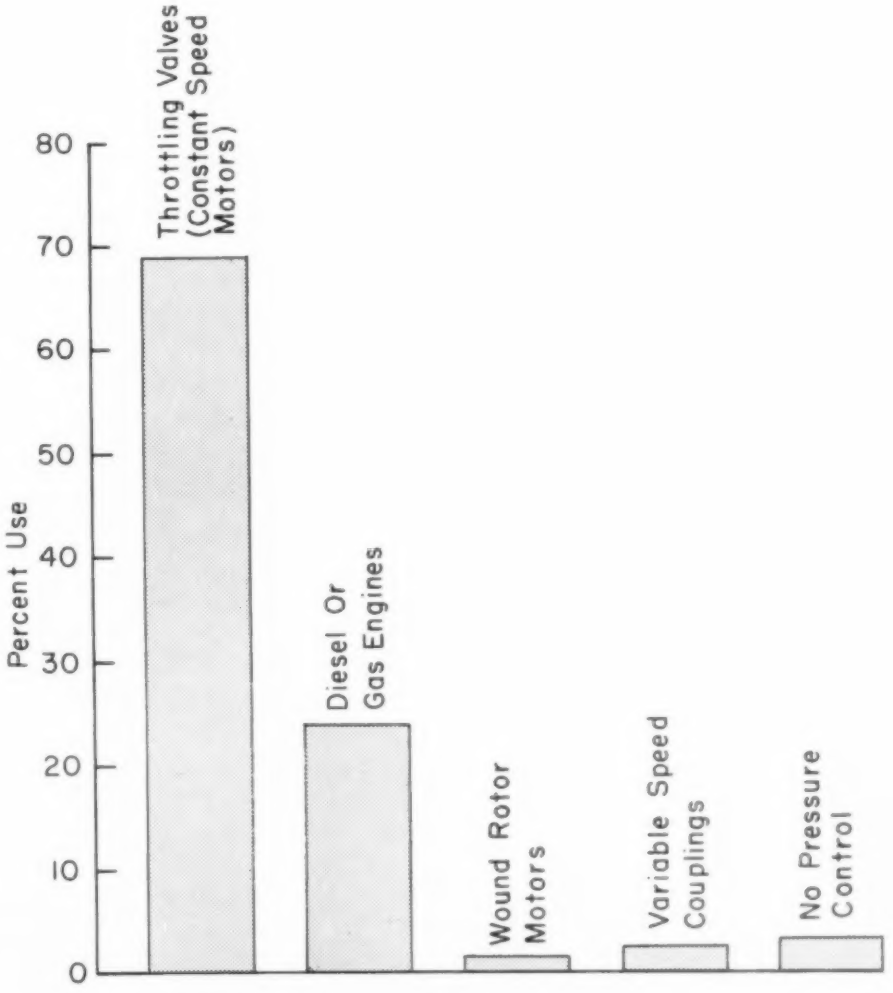


FIGURE 4—Pressure regulating equipment now in use.

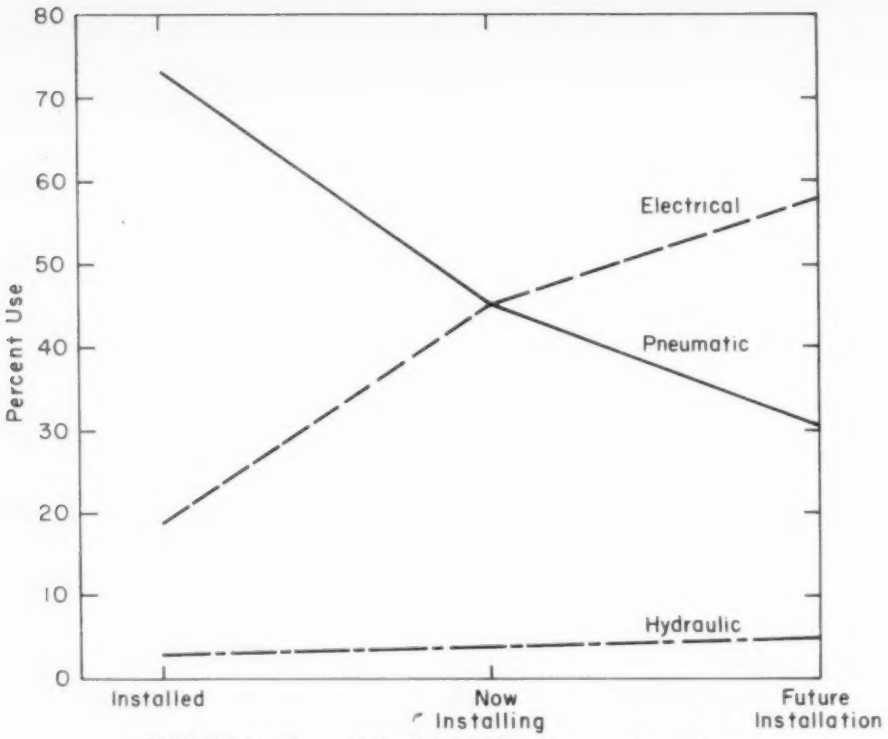


FIGURE 5—Types of throttling valves in use and predicted.

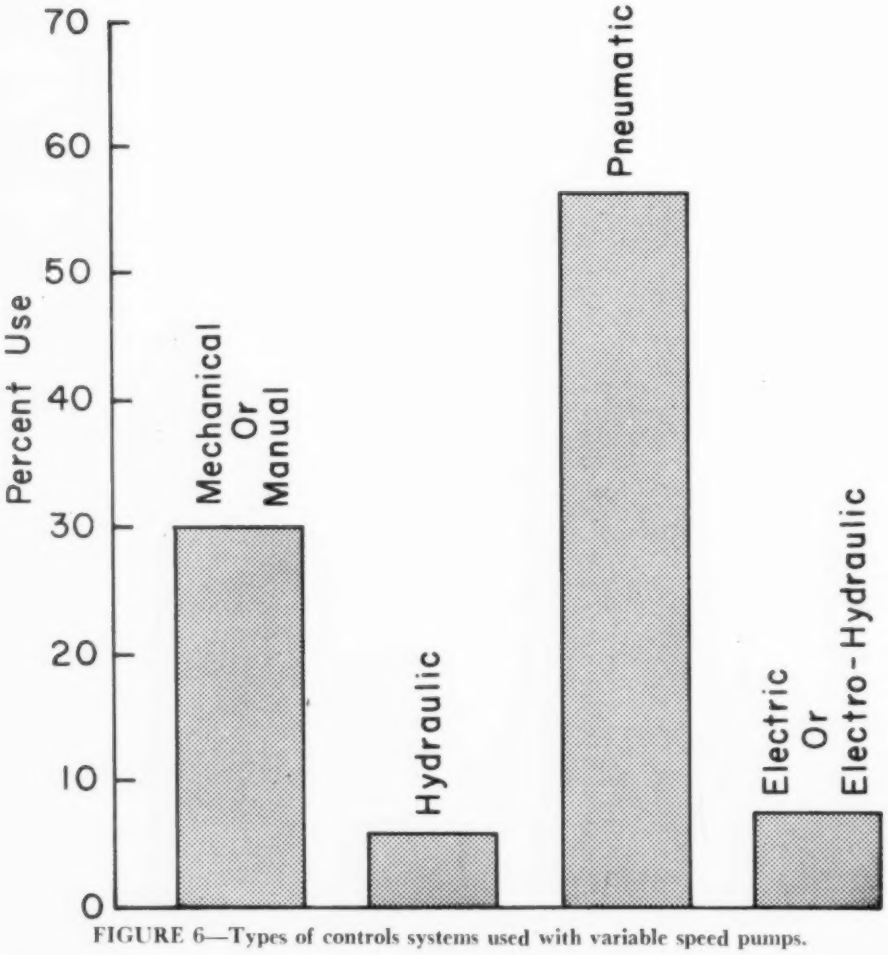


FIGURE 6—Types of controls systems used with variable speed pumps.

- Batch change or interface indicator
- Flow direction indicator
- An indicating float switch
- Pressure and temperature transducers.

All of the devices indicated as desirable and required usually carried several qualifying words such as, *better, reliable, dependable,* or *inexpensive.* Although all of the devices mentioned are available in some form there appears to be a need for better devices of all types.

PRESSURE REGULATING EQUIPMENT

Since there are several ways of regulating pressure, both the pressure control systems utilizing reducing or throttling valves and those systems utilizing variable speed pumps were considered.

Prime movers considered include constant speed units utilizing throttling valves, variable speed equipment such as diesel engines, wound rotor motors, and constant speed motors with some form of variable speed coupling. Figure 4 indicates that of the units being used at present, 69 percent are constant speed utilizing throttling, 24 percent diesel or gas engines, 1.5 percent wound rotor motors, 2.5 percent variable speed couplings, and 3 percent with no pressure control.

For the purpose of this survey, the definition of an electric, pneumatic or hydraulic throttling valve control system was that the control signal supplied to the valve operator was of the type mentioned, this is not necessarily the same source of power which actually operates the valve. For example, an electrical control system which was connected to an electro-hydraulic valve would be considered an electrical type system and not a hydraulic system.

Controls for Throttling Valves. Various types of pressure control used with throttling valves were divided into three main categories—pneumatic, electric and hydraulic. Results presented in Figure 5 are:

- Much larger number of pneumatic valve controls
- Use of hydraulic controls increasing slightly but not being used as much as pneumatic or electric

Greater use of electrical pressure control equipment forecast

- Future trend indicates continued decline of pneumatic control with electric systems receiving more application.

Variable Speed Systems. Figure 6 illustrates the type control systems used with variable speed pumps.

- Mechanical control systems (including manual control) accounted for 30 percent of the installations
- Pneumatic control was used in 56½ percent of the installations
- Electric or combination electro-hydraulic systems accounted for 7½ percent
- Hydraulic systems account for only 6 percent of the total.

The cumulative percentage of wound rotor motors and variable speed couplings is 4 percent. However, this is not a strictly comparable situation. Generally speaking, a wound rotor motor is most applicable where the starting requirements of the power system are so small that very little inrush is permissible. By proper choice of starting and speed control resistors, the wound rotor motor can be eased onto the power system with the minimum drain imposed on the power lines. If resistors are used as the secondary control, only steps of speed control are obtainable.

Using variable speed couplings is of no assistance in reducing the maximum inrush demand placed on the power system during starting. Since the coupling can be arranged so that the motor would start unloaded, there is some reduction in the length of time the inrush is imposed upon the power system, but it in no way limits the maximum demand. The variable speed coupling will provide a smooth and continuously adjustable speed control, contrasted to the step control of the wound rotor motor.

Speed ranges utilized by the adjustable speed units varied from a maximum of 50 percent (50 to 100) to a minimum range of 20 (80 to 100) percent. As shown in Figure 7, the actual hydraulic horsepower (pump output) utilized at the various speed points on the curve is shown with a corresponding "throttling" loss.

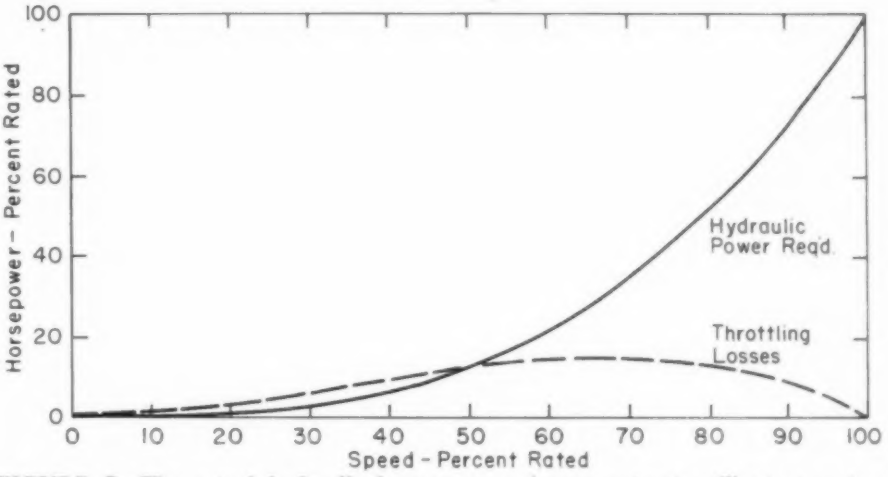


FIGURE 7—The actual hydraulic horsepower (pump output) utilized at various speeds. Also illustrated is the corresponding "throttling" loss at various speeds.

Constant speed motors used in conjunction with throttling valve control generally do not have individual throttling control. Consequently, the use of multiple units in a station with a single throttle valve usually indicates the maximum throttling losses encountered can be limited to the size of the smallest unit installed.

Equipment Needs. There seems to be very little equipment which is not available. The following two items were listed as being necessary or desirable:

- Class 1 Group D approved electric type variable speed coupling
- An all-electric throttling valve control system, utilizing electrical signals and electric power to position the throttling valve.

ACKNOWLEDGMENT

From a paper presented at the American Institute of Electrical Engineers' Petroleum Industry Conference, Dallas, September 15-17, 1958.

Part 2 will conclude this report in the December issue of PIPE LINE INDUSTRY.

About the Author

E. B. Turner, application engineer in General Electric's system application engineering section, has devoted several years experience to the development of control equipment for pipe line pumping and compressor stations. He has presented several papers before engineering groups on design and engineering of automatic pipe line control systems. After service in the Navy during World War II, Turner returned to Texas A & M College and completed studies in electrical engineering in 1949. He taught in the electrical engineering department of the college, then went into construction work with Ebasco Services, Incorporated, joining General Electric in 1951. Turner has written several articles on automatic control design for PIPE LINE INDUSTRY and other leading industry magazines.

FIGURE 1—Texas Eastern's Station 27 at Linden, N. J., has three large reciprocating compressors controlled remotely from Lambertville, 50 miles upstream. All operating and safety functions are monitored by electrical and mechanical devices. This station is started up periodically during mid-winter months to boost gas delivered to New York area customers. While in operation, it will be unattended and locked up.

Dependability and Safety in . . .

Unattended Stop-and-Go Reciprocating Station

Three variable-speed units are controlled at Linden, New Jersey from point 50 miles upstream. New station boosts pressure periodically on line serving New York area distribution customers

By F. Vinton Long, Richard J. Mathias and William L. Fouche
Texas Eastern Transmission Corp., Shreveport, La.

DESIGN THINKING in the Linden, N. J., station of Texas Eastern Transmission Corporation had to take into consideration a variety of important factors. It was the company's first venture into fully remote operation for a compressor station; it was also the first unattended operation of a large reciprocating compressor in gas transmission service.

Function of the Linden station is somewhat unusual; it is the terminal station on Texas Eastern's transcontinental system and boosts pressure to a distribution customer in the New York area. It is intended to operate only one or two months a year, and often for only one or two days or perhaps even a few hours at a time.

There must be a lot of starting and stopping of units and frequent changes in speed settings of the variable-speed prime movers. All of these demands put a premium on top equipment performance and high serviceability when the station is called upon to serve the customer.

Three reciprocating gas compressor units are installed at Linden; provisions have been made to add three more. Units are presently being operated remotely from a second station at Lambertville, N. J., approximately 50 miles upstream. Engines and compressors are installed in a building well separated from the Linden control room. The control room houses switch gear, sequence control equipment and supervisory control panels. Control batteries, the emergency power plant and air compressors are also installed at this location.

Communications Design Approach. At a station with a number of vital functions in control, such as that required at Linden, it was felt desirable to provide the maximum of communication facilities needed to accommodate all types of control functions required. It is possible to obtain continuous feed-back intelligence by leasing several narrow band signaling circuits for telemetering functions; however, if one adds up the quantity of these circuits required, it may be found cheaper to lease one telephone-type channel and provide multiplexing equipment rather than lease a number of narrow band lines. This was the design approach used on the Linden station control system.

It should be brought out that the narrow band signaling grade channel is essentially a D.C. loop circuit; it cannot control and receive back intelligence simultaneously. Nor is it possible to receive back more than one telemetered intelligence at the same time. When it is necessary to control gently the speed of a reciprocating engine, a turbine, a recycling valve or a suction valve which is important in operations, it is necessary to receive back continuous telemetered information concerning the state of the equipment being controlled even while controlling signals are being transmitted to change it. This is true "closed loop" or "full feed back" operation and automatically eliminates use of narrow band or series loop type circuits.

D.C. operation was specified for the Linden control station and the Lam

ertville controlling office. Control quipment is engineered to operate irectly off 130 volts D.C. thereby liminating many transformers, acuum tubes and rectifiers.

The same 130 volt D.C. source is sed to operate the Linden switch ear. This power system makes for fficient dependable operation—a aluable feature if A.C. power is lost or if the A.C. stand-by plant fails to ome on because of weather conditions or other causes. In such an event tele-control apparatus will still function. Actually the controlled station will operate without any A.C. power at all under this design.

Extensive Telemetering Utilized. The amount of information to be transmitted between a satellite station and the control station is not a definite quantity. Design engineers had to take into account these factors:

1. Minimum information required for station operation whether the station is to operate continuously, intermittently or for peak loads.

2. Information needed by the company for future design.

3. Specialized information to provide research on difficulties that may apply to certain stations, or those of a certain size or at a specific location.

To control a multi-unit reciprocating station remotely the manual functions normally performed by station operators must be accomplished by automatic means. This requires transmittal of a large volume of intelligence—both for control and information. There are 63 function checks coming back from Linden to the control center at Lambertville.

This includes such information as station suction pressure, station discharge pressure, station suction temperature, station discharge temperature, station ambient air temperature and engine speeds for each unit. Control functions include (for two state operations): Start and stop for each engine; speed increase or decrease for each engine; load or unload signal for Valves 1 and 2 on each engine; and a closed or open setting for Pockets 1 and 2, or 3 and 4 on each engine.

Single state functions include station emergency shutdown or station indication check.

Telemetering Shows Significant Speed Changes. The telemetering system used for engine speed indication is of the relatively high-speed type. When properly adjusted, the indicators will show the speed of the units five times each second. Even with an allowance for lagging and dampening effects, this is fast enough to show meaningful fluctuations of speed.

Since changes of the other indicated variables are relatively slow, a slower type telemetering system is used. Each of these units has a 15-second cycle; once each 15 seconds the indicating needle coincides exactly with the quantity as measured at Station 27. Indicators for suction pressure, discharge pressure, suction temperatures discharge temperatures and ambient air temperatures are of this type.

Valve Operation. Main valves have gas-actuated operators equipped with limit switches. A storage tank floating at line pressure provides the necessary gas pressure to insure valve closure in case of line breaks. Unit suction, discharge and recycle valves are all automatically opened and closed in proper sequence by means of solenoid valves which control the pressure to the gas operators. Solenoid valves are operated at the proper time by the electrical sequencing equipment.

Pressurizing and vent valves are electric-open and spring-close type. Failure of electric power results in closure of these valves.

Solenoids Actuate Engine Controls. Engine controls such as starting air, jet air, pockets, cylinder valves and fuel gas are operated by electric solenoid controls. These are operated in the proper order by the electrical sequencing equipment. Adjustment of cooling water valves, oil valves, hydraulic oil valves etc. is accomplished by means of automatic valve operators. Such functions as dumping scrubbers, filling engine lu-

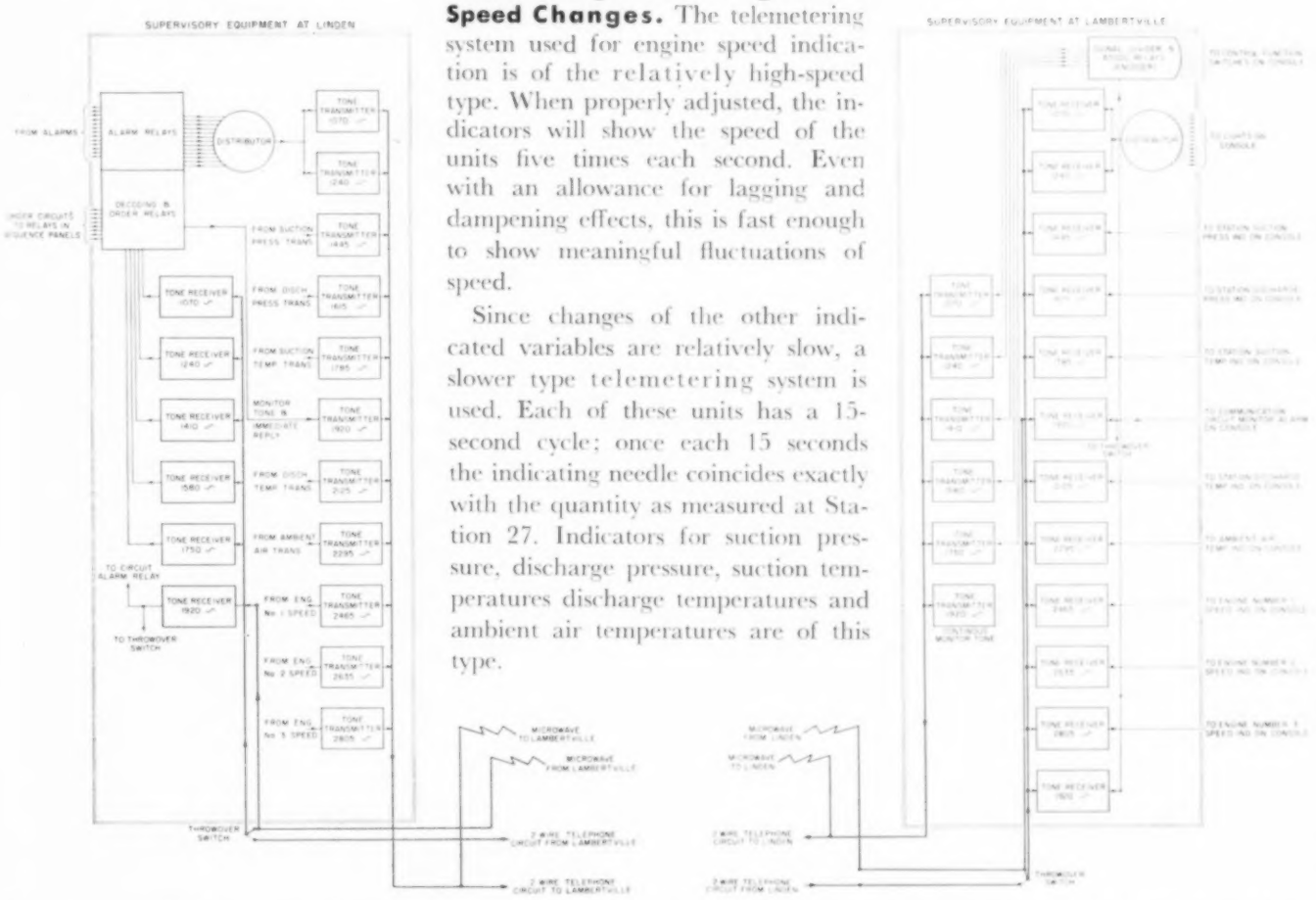


FIGURE 2—Block schematic shows details of the supervisory control—communications link between Lambertville and Linden.

bricators and making up engine lubricating oil are automatically performed. Automatic motor-driven auxiliary lube oil pumps provide engine prelubrication.

The engine ignition system is independent of A.C. power and includes automatic spark control. The governor can be remotely controlled; automatic operation of the fuel gas valve in conjunction with the governor is also provided. Engines have automatic provisions for warm-up, run-back after shutdown, load control, etc. Cylinder valves and pockets for loading the engine are remotely controllable.

The water cooling system is automatically regulated; Linden station has a separate system for each engine equipped with hydraulic driven motors in the forced draft air cooled exchangers. These motors are regulated for speed by a temperature-controlled bypass valve. Lube oil cooler requirements match jacket water requirements; one three-way mixing valve can control temperature of water entering engine and the amount of water going through lube oil cooler. Building heaters are provided to keep engines and lube oil warm during winter.

Liquid levels, oil and gas pressures, oil, gas and engine temperatures etc. are equipped with detection devices for station and engine protection and to indicate status of operation for control by automatic sequence equipment; they also provide alarm, shutdown, lockout or blowdown action, as required. Devices detect such conditions as crankcase explosion, engine overload, vibration, overspeed, high discharge gas pressure and temperature and engine rod and cylinder temperature.

Safety Devices Installed. Detecting devices are also incorporated in the Linden station to replace some of the human senses of the operators, such as monitoring valve position, engine and station conditions, fire, explosive mixture and unauthorized entry of personnel.

Fire is detected by means of a device which senses presence of combustion product particles by the comparative ionization method. Explosive mixture is detected by another device: when hydrocarbons are deposited on a heated element they raise the resistance of the element and upset a balanced bridge circuit to actuate a signal.

Illegal entry is detected by switches on each door. Authorized entry to the station without actuating an alarm

LEGEND

A — DENOTES AN ALARM CONDITION INDICATED AT EITHER THE LINDEN STATION OR THE LAMBERTVILLE STATION, OR BOTH.

P — DENOTES A PERMISSIVE REQUIREMENT THAT MUST BE FULFILLED BEFORE THE SEQUENCE CAN PROCEED. WHEN THIS REQUIREMENT APPEARS IN STEP 1, THE CONDITION MUST BE MET BEFORE THE SEQUENCE WILL BEGIN. IN THE OTHER STEPS THE CONDITION MUST BE FULFILLED IN TIME FOR THE ENTIRE SEQUENCE TO BE COMPLETED WITHIN 30 MINUTES AFTER START OR THE UNIT WILL BE SHUT DOWN.

SD — DENOTES CONDITIONS THAT WILL SHUT THE UNIT DOWN IF THEY OCCUR DURING THE INDICATED STEPS. THEREFORE THESE CONDITIONS ARE ALSO PERMISSIVE. SHOULD THE UNIT BE SHUT DOWN BY ONE OF THESE CONDITIONS, THE UNIT MAY BE RESTARTED SUCCESSFULLY AFTER THE CONDITION HAS CLEARED.

LO — DENOTES CONDITIONS SIMILAR TO THOSE ABOVE, EXCEPT THAT UPON OCCURRENCE THE UNIT IS SHUT DOWN AND LOCKED OUT AND REQUIRES THAT PERSONNEL VISIT THE STATION TO RESET THE PROPER DEVICE.

BD — DENOTES CONDITIONS SIMILAR TO THOSE ABOVE, EXCEPT THAT THE STATION PIPING IS "BLOWN DOWN". STATION VALVES ARE CLOSED, ETC. PERSONNEL MUST VISIT THE STATION TO OPEN VALVES, RESET CIRCUITS, ETC.

NOTE

A PATH IN AND OUT OF THE STATION THROUGH THE STATION VALVES AND THE LINE VALVES IS REQUIRED FOR STARTING AND FOR THE PERMISSIVE LAMPS IN LAMBERTVILLE. AFTER STARTING, ALL UNITS ARE SHUT DOWN AND TIME A VALVE NEEDED FOR THIS PATH BEGINS TO CLOSE. AS INDICATED ON THIS CHART, AN INCORRECT POSITION OF UNIT VALVES RESULTS IN A SHUTDOWN AND LOCKOUT OF THE PARTICULAR UNIT. FIG. NO. 2 INDICATES THE REQUIRED POSITION OF UNIT VALVES FOR STARTING AND FOR THE PERMISSIVE LAMP.

No.	ANNUNCIATOR DROPS AT LINDEN — TITLE	STATION OR UNIT DROP NO.	DEVICE DESIGNATION — ORIGINAL	AUXILIARY
	STATION DEVICES (Common To All Units)		(Station Panel)	
1	LOW STARTING AIR PRESSURE	1	PS 5	63 A4 X
2	LOW INSTRUMENT AIR PRESSURE	2	PS 9	63 A1 X
3	EMERGENCY SHUTDOWN	3	VARIOUS	5 E X
4	HAZARDOUS ATMOSPHERE DETECTED	4	DAVIS DETECTOR	45 HA X
5	FIRE DETECTED	5	PYR-A-LARM DETECTOR	45 FD X
6	LOW BATTERY VOLTAGE	6	STA. BTRY UV RELAY	27 DC X
7	LOW FUEL GAS PRESSURE (HEADER)	7	PS 7	63 GF1 X
8	LOW BUILDING TEMPERATURE	8	TS 11	26 A1 X
9	ILLEGAL ENTRY	9	DOOR SWITCHES	14 IE X
10	POWER COMPANY NORMAL	10	A. C. UV RELAY	27 N X
11	EMERGENCY GENERATOR RUNNING	11	AUX. GENERATOR VOLTAGE RELAY	
12	ENGINE BATTERY LOW VOLTAGE	12	AUX GEN BTRY UV RELAY	27 GB X
13	UNIT #1 D. C. CONTROL OFF	13	CUB. #1 UV RELAY	27 1 X
14	UNIT #2 D. C. CONTROL OFF	14	CUB. #2 UV RELAY	27 2 X
15	UNIT #3 D. C. CONTROL OFF	15	CUB. #3 UV RELAY	27 3 X
16	SWITCHGEAR CONTROL OFF	16	STA. CUB. UV RELAY	27 X X
17	SUPERVISORY D. C. CONTROL OFF	17	SUPVRY CUB. UV RELAY	27 S X
18	FIRE DETECTOR DISABLED	18	MONITOR RELAY	27 6 X
19	GAS DETECTOR DISABLED	19	MONITOR RELAY	27 7 X
20	HIGH DISCHARGE PRESSURE	20	PRESSURE SWITCH	63 HDP X
	UNIT DEVICES (Typical of Each Unit)		(Unit Panel)	
21	ENGINE VIBRATION	1	VIBRATION SWITCH	39 V1 X
22	FIN FAN VIBRATION	2	VIBRATION SWITCH	39 V2 X
23	PIPING VIBRATION	3	VIBRATION SWITCH	39 V3 X
24	ENGINE OVERSPEED	11	FLYWHL OVRSPD SWTCH	12 E X
25	TURBO UNIT OVERSPEED	15	PS 17	63 AS X
26	ENGINE OVERLOAD	7	PS 13	63 GF2 X
27	CRANKCASE EXPLOSION	10	PS 1	63 AB X
28	LOW LUBE OIL LEVEL	9	LA 3	71 QL X
29	HIGH LUBE OIL TEMPERATURE	12	TS 3	26 QH X
30	LOW LUBE OIL PRESSURE	4	PS 2	63 QL X
31	HIGH LUBE OIL LEVEL	13	LA 3	71 QL X
32		NONE	TS 7	26 QL X
33		NONE	PS 6	63 QL X
34		NONE	VARIOUS	88 QJ
35	LOW JACKET WATER PRESSURE	6	PS 3	63 W X
36	LOW HYD. OIL PRESSURE	5	PS 4	63 HY X
37	LOW JACKET WATER LEVEL	10	LA 2	71 W X
38	LOW HYD. OIL LEVEL	8	LA 1	71 HY X
39	HIGH JACKET WATER TEMPERATURE	13	TS 2	26 W1 X
40	HIGH HYD. OIL TEMPERATURE	11	TS 4	26 HY X
41	COMP. ROD NO. 1 HIGH TEMPERATURE	20	TS 1	38 HR1 X
42	COMP. ROD NO. 2 HIGH TEMPERATURE	21	TS 1	38 HR2 X
43	COMP. ROD NO. 3 HIGH TEMPERATURE	22	TS 1	38 HR3 X
44	COMP. ROD NO. 4 HIGH TEMPERATURE	23	TS 1	38 HR4 X
45	COMP. CYL. NO. 1 HIGH TEMPERATURE	24	TS 8	26 GC1 X
46	COMP. CYL. NO. 2 HIGH TEMPERATURE	25	TS 8	26 GC2 X
47	COMP. CYL. NO. 3 HIGH TEMPERATURE	26	TS 8	26 GC3 X
48	COMP. CYL. NO. 4 HIGH TEMPERATURE	27	TS 8	26 GC4 X
49	HIGH GAS DISCHARGE TEMPERATURE	14	TS 6	26 GD1 X
50	VALVES OUT OF SEQUENCE	17	VALVE LIMIT SWITCHES	1 VDS
51	INCOMPLETE SEQUENCE	19	30 MIN CONTACT ON TMR	48 T 6 X
52	IGNITION FAILURE OR ENGINE STALL	25	IGNITION RELAY ET AL.	3 PS
53		NONE	PS 16	63 AT
54		NONE	PS 14	63 AR
55		NONE	10 MIN CONTACT ON TMR	48 T
56		NONE	TS 10	26 Q1
57		NONE		26 W1
58		NONE		26 GD1
59		NONE	SR	
60		NONE	LIMIT SWITCH	65 LRS
61		NONE	LIMIT SWITCH	65 MRS
62		NONE	A1	

FIGURE 3—Chart shows control and safety monitoring devices for Linden station. Discrepancies from normal conditions will either prevent starting, if the engine is stopped, or sound an alarm, shut down, lockout, or blowdown the station, as indicated.

About the Authors

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Mathias

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F. Vinton Long, chief of the Communications and Control section in the Engineering department of Texas Eastern Transmission Corporation, has written several papers on communications and control for gas transmission lines. He was in communications positions with Pan American Airways and Mene Grande Oil Company in Latin America. Before joining Texas Eastern in 1950, he was with Westinghouse Electric International Company and Wilcox Electric Company. His responsibilities with Texas Eastern have centered around design and construction of 1,700 miles of microwave radio links for pipe line use, and important engineering features in the telecontrol system for the unattended station at Linden.

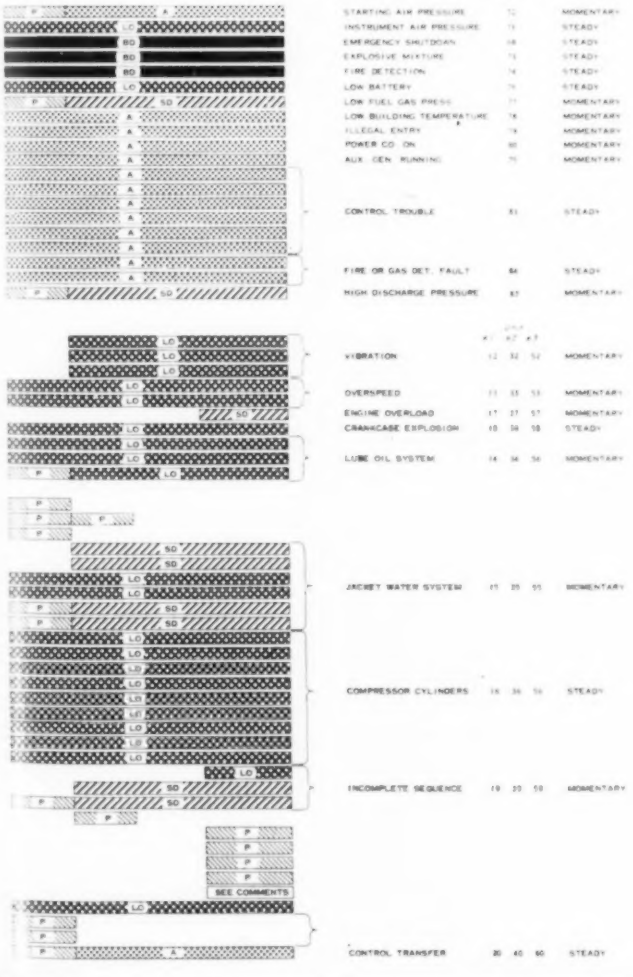
Richard J. Mathias, presently on loan to the Engineering department of Texas Eastern, is in charge of the installation of the remote control equipment for control of the Linden station. In 1951, Mathias joined Texas Eastern and served as engineering inspector. A native of Ohio, Mathias, served four years in the USAAF where his duties included teaching assignments at the Chanute field school and the Yale University cadet program. Following the war he returned to American Telephone and Telegraph Company as a transmission man and equipment maintenance man. He later was equipment supervisor.

William L. Fouche has completed electrical engineering assignments on several construction projects. Prior to joining Texas Eastern in 1957, he was employed by Carter Oil Company and Mene Grande Oil Company in Venezuela. A 1940 graduate of Louisiana Tech in Mechanical-electrical engineering, Fouche did further study in physical sciences at the University of Chicago and the University of California. During USAAF service he completed assignments as a weather officer and multi-engine pilot.

LINDEN COMPRESSOR STATION

(CONTROLLING STATION - LAMBERTVILLE)

PRINCIPAL PROTECTIVE & INDICATING DEVICES



HOW THE LINDEN STATION IS STARTED UP AND OPERATED FROM LAMBERTVILLE

Figure No. 4 illustrates the actual physical layout of the lamps and switches on the escutcheons of No. 1 engine panel and the station No. 27 panel at Lambertville. The Linden station panel and three engine panels are installed in the control console at Lambertville; space is provided for three additional engine panels.

All of the lamps of the control console are controlled by the position of the relays in the nearby relay cabinet. Relays in turn are positioned to either the red or green position in accordance with one of two tones received during the scanning cycle.

Change of any condition being monitored by the supervisory equipment of Station 27 initiates a scanning cycle; a rotating arm of a switch touches a series of contacts in sequence, one at a time. Each of the alarms takes its turn in transmitting a red lamp or green lamp condition to Lambertville.

During the time the wiping arm is on a particular contact it permits either a tone corresponding to the red lamp condition or one of the green lamp condition to be transmitted to Lambertville, depending on whether or not the monitor relay in the supervisory equipment is energized.

While the scanner at Linden is in a scanning cycle, a similar distributor at Lambertville is stepped from relay to relay in synchronization with the distributor at Linden. In this manner only two tones or two subchannels are used to time-multiplex the transmission of alarms, permitting the position of over 90 alarms to be indicated over the communication channel within the 18-second period of one scanning cycle.

Escutcheon No. 2, titled "ENGINE NO. 1" contains the controls for starting and stopping Engine No. 1. If the engine is in the "stop" position, the green lamp should be lighted. If the engine is operable, the amber lamp should also be lighted, indicating that all conditions permissive to starting are fulfilled. It should be possible to start the engine by turning the key switch to the "start" position and, simultaneously, operating the "operate" switch located below it on the escutcheon. These two switches are held in position until the blue lamp lights. When this lamp lights, it indicates that the signal has been received at Linden and that the master sequence starting relays have been energized. Both switches may then be released.

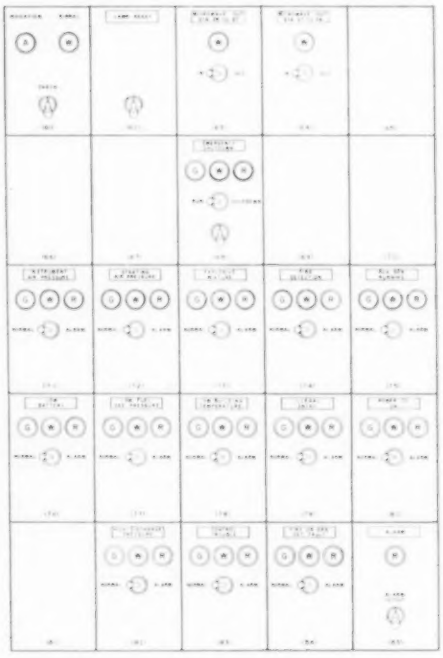
As the starting sequence gets under way, a distributor cycle will be started and will turn out the amber lamp. When the engine begins cranking and comes up to a speed of approximately 50 to 75 rpm, another distributor cycle will be started which will turn out the green lamp. From this point until the engine is warmed up and ready to load, only the blue lamp is on indicating that the engine is still in sequence. Speed increases will be indicated on a tachometer on the back of the board. After the unit is warmed up the unit suction and discharge valves are open, and all other unit valves closed, another distributor cycle will be started and the blue lamp will be extinguished. Then the red lamp will light, indicating that the unit it ready to load.

- Stopping Procedure. The engine is stopped in a like manner, i.e., the start-stop switch must be put in the "stop" position and held while the "operate" switch is operated. These switches should be held in position until the white light of Escutcheon No. 61 lights to indicate that the signal has been received at Linden. After the engine has stopped, scan cycles again restore the lamps to indicate a stopped condition.

- Governor Speed Settings. The governor switch of Escutcheon No. 3 is a spring-loaded bar switch which may be operated in either direction. Holding the switch to the left position lowers the governor setting and holding to the right raises the speed set of the governor at Linden. The time during which the governor is actually being set is indicated by the white lamp of Escutcheon No. 61.

- Cylinder Valve Control. No. 4 Escutcheon controls the cylinder valves on the No. 1 compressor cylinder of Engine No. 1. It has a

STATION 27



ENGINE NO. 1

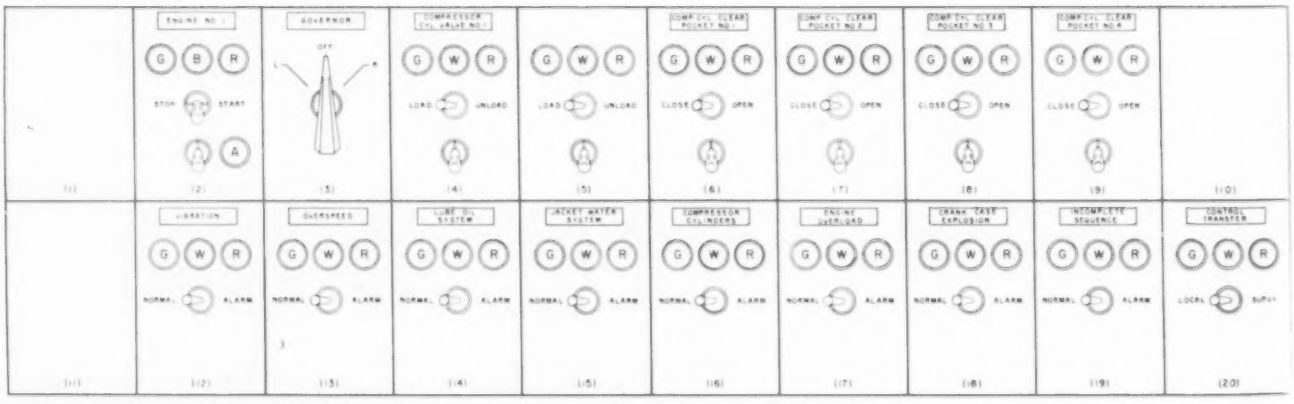


FIGURE 4—Escutheons for controlling Engine No. 1 and overall functions of Station 27. Panels for the other two engines are below No. 1 engine panel at the left side of the console desk top at Lambertville.

green lamp, white lamp, red lamp, a metallic toggle switch and operating switch.

The green lamp indicates that the cylinder is in the loaded position; the red lamp indicates the unloaded position. When the white lamp is lighted, it shows that the actual position of the cylinder valve disagrees with the position in which the metallic switch has been left.

Should this cylinder valve position be changed locally at Linden, or by any means other than normal operating procedure from Lambertville control, an audible alarm will be sounded.

To load the compressor cylinder valve No. 1, the metallic switch is placed in the load position and the key switch held on until the white lamp lights on Escutcheon No. 61. Lamps on the cylinder valve escutcheon should then change, since this is an immediate-type operation.

Escutcheons Nos. 5, 6, 7, 8 and 9 operate in similar manner.

If the operator at Lambertville keeps the metallic switches aligned so that all of the white disagreement lamps are out, he has a positive record of the position in which he left all of these types of controls. Should he be absent from the control console and hear an audible alarm, he may determine immediately upon returning which, if any, of these escutcheons changed position by observing which white disagreement lamp is lighted.

Without these white disagreement lights he would have to maintain a written record to determine which valves or pockets had changed position causing the audible alarm.

All of the escutcheons in the bottom row of the Engine No. 1 panel are strictly alarm escutcheons. The metallic toggle switch serves only to turn out the white disagreement lamps.

Each alarm escutcheon is either momentary or steady. This designation is intended to describe the type of signal that actuates the alarm.

• Momentary Alarm Functions. To explain a momentary-type alarm operation such as that of Escutcheon No. 12 assume that the green lamp is lighted, indicating normal or no-alarm condition of vibration. Then if the metallic switch is in the left-hand position pointing toward the green lamp and the "normal" written on the escutcheon, the actual condition will be in agreement with the switch, and the white or disagreement lamp will be out.

If during the absence of an operator one of the protective devices monitoring vibration should detect vibration, the green lamp will be turned off, the red and white lamps will be turned on, and an audible alarm will sound and continue the sound until the alarm reset has been pushed.

Because vibration will shut the unit down, and shutting the unit down clears the vibration within a short period of time the vibration monitoring device will no longer be giving a signal that the unit is in vibration.

Then the red lamp will be extinguished and the green lamp will be lighted, but it is a particular feature of this momentary-type alarm that since the green shifted to red, even though it is now back at green, indicating a normal condition, the white lamp having lighted remains lighted until reset. To reset or turn out the white disagreement lamp of any of the momentary-type alarms, all of the metallic toggle switches of all momentary alarms must be in the agreement position, i.e., pointing toward the lighted lamps; then the reset switch of Escutcheon No. 62 must be operated.

For this momentary-type alarm, the white disagreement lamp furnishes the only record of what has happened since the condition corrected itself before the operator returned to the control console.

• Steady Alarms. Escutcheon No. 16, 18, and 20 are steady-type alarms. The signal that originates or operates the alarm escutcheons is expected to be of the type that once the signal begins, it lasts a sufficient length of time for the operator to get to the board and note what has happened. In alarms of this type the disagreement white lamps on each escutcheon are operated individually by aligning the metallic switches to be in agreement with the actual condition, i.e., pointing toward the lighted lamp.

It is not necessary to operate the lamp reset switch of Escutcheon No. 61 to turn out these white disagreement lamps. In this instance the white disagreement lamp furnishes only a record of the condition in which the board was left. Thus it may be possible to leave the board with one alarm on, indicating, for example, that one of the compressor cylinders was in the alarm condition. If the white lamp is turned out, then the next time this condition occurs and the audible alarm is received the operator may reset the audible alarm. Upon returning to the console he may determine whether or not a particular steady type alarm escutcheon caused the condition that originated the audible alarm by noting the condition of the white disagreement lamps. It is not necessary to maintain a written record of the conditions of each alarm to determine which ones changed when the audible alarm was heard.

• Station Panel Group. Only two of the escutcheons of the station group are control functions. The first is Escutcheon No. 61 in the top left-hand corner. This escutcheon contains an amber lamp, a white lamp and a black key-type operating switch.

The amber lamp is lighted only during the time that the distributor cycle is in progress. A distributor cycle is usually initiated by any change of alarm condition that is not an ordered change, i.e., is not made during the time a particular key switch is being operated by the operator at Lambertville.

In case there is sufficient noise or interference with the communication circuit during the distributor cycle such that the rotating switch or distributor at Lambertville gets out of step with the one at Linden the lamps on the board at Lambertville will be extinguished and the audible alarm will be sounded. For such occasions, the key switch permits the operator to recheck the indication of the alarms.

Holding the key switch of this escutcheon operated until its white lamp is lighted will initiate a distribution cycle as soon as the switch is released. The white lamp indicates that a signal leaving Lambertville has been received and recognized by the supervisory equipment in Linden and that the final relay in the specific function supervisory equipment is in the energized position.

From the time an operating switch is first actuated, approximately two seconds are required for the lamp to light. It remains lighted until the switch is released.

Should the lamp fail to light, it is an indication that the power is off to the supervisory equipment at Linden, that there is no communication circuit, or that there is a malfunction in some part of the system.

• Emergency Shutdown Sequence. The emergency shutdown, Escutcheon No. 68, is the other control function of the station group. To effect an emergency shutdown of Station 27 from 26, the metallic switch must be placed to the right to the "shutdown" position and the key switch activated and held activated until the white lamp of No. 61 indicates that the signal has been received at Linden.

The green lamp to the left and the red lamp to the right shows whether or not the station at Linden is in the "blown down" condition. The red lamp remains lighted after a blowdown until its associated circuits have been reset. A white disagreement lamp works in a manner similar to other types of steady alarms.

Other escutcheons of the station group are station alarms with the exception of Escutcheon No. 85; it has the key switch to silence the audible alarm. Operating this key silences the alarm and resets the alarm circuits.

The meters indicating the telemetered information from Linden and a mimic piping layout are located on the back of the control console above the escutcheons. To the left of the board are the engine speed indicators.

can be made by operating a bypass switch with a key.

Figure 3 illustrates the principal protective devices and their function in the electrical sequence. This presents the nomenclature that appears on the station and unit annunciator drops at Linden; the devices originating the signal; the auxiliary devices necessary to relay the signal; the function of each of these devices in the electrical sequence; nomenclature on the control panel escutcheons at Lambertville; the escutcheon number and the type of alarm.

Linden May Set Trend for Future Stations. Worthwhile experience is being gained from transmittal of a considerable volume of data between the control center at Lambertville, N. J., 50 miles upstream, and the Linden station. Future operating results will show just how much of this information is absolutely essential for control.

Design features at Linden might not necessarily be the optimum for other reciprocating stations. As a matter of fact, they may not even be typical of later techniques employed by Texas Eastern; operating experience with the many ideas applied here will probably point the way to further improvements and economy.

Many things have already been learned from operation of the Linden station. For one example, it may well be desirable in a future station of similar design to install recording charts on vibration meters. Vibration alarms provide safety now, but it would be interesting to be able to have a record of equipment vibration if the engine were to be shut down in the absence of an operator.

Every effort was made in design to have an unattended station that would actually be safer and more efficient in operation than a conventional manned one not equipped with automatic telecontrol equipment. With automatic supervision it is possible to constantly guard every vital part of each piece of station equipment. Regardless of his capability and experience a human operator could not possibly be watching every key function at once; so more intense supervision and control is accomplished automatically.

If things do go wrong, electrical and mechanical devices automatically operate much faster than man's hands; nor are they concerned with the natural reaction for survival when a serious emergency may be imminent.

—The End

DETAILS OF START-UP SEQUENCE

When starting an engine from Lambertville, a lighted amber lamp on Escutcheon No. 2 indicates that these permissive start requirements have been met:

1. One or more of the three line discharge valves at Station 27 is open.
2. One or both of the two line suction valves is open.
3. The station discharge valve and the station suction valve are open.
4. The station blowdown valve is closed.
5. Station instrument air pressure is above 80 pounds.
6. The station D.C. bus voltage is above minimum voltage.
7. No hazardous atmosphere or fire has been detected since the circuits were reset.
8. No emergency shutdown has occurred since this circuit was reset.
9. Station fuel gas is above 20 pounds.
10. The pressure of the discharge gas is below the set point.
11. Jacket water temperature is below 180° F.
12. Hydraulic oil temperature is below 140° F.
13. The temperatures of each of the four compressor rods is below 210° F.
14. The temperature of each of the compressor cylinders is below 220° F.
15. The hydraulic oil level is above the set level.
16. Lube oil temperature is below 170° F.
17. Lube oil level is above set level.
18. Jacket water level is above set level.
19. The engine has not tripped the overspeed switch since it was reset.
20. Discharge gas temperature is below 200° F.
21. The lockout relay has been reset since the last lockout.
22. Unit recycle valve is open.
23. The unit discharge valve is closed.
24. The unit suction valve is closed.
25. The governor has been run back to the set point for idling speed.
26. Starting air pressure is above 200 pounds.
27. Unit ignition is off.
28. Lube oil temperature is above the permissive set point.
29. The pressurizing valve is closed.
30. The vent valve is open.
31. The unit has not been started unsuccessfully and then shut down within the last 30 minutes, unless a stop order was transmitted.
32. Unit lube oil pressure is below 20 pounds.
33. Power is available to the lube oil motor contactor and the lubricator motor contactor, and their associated overloads have not been tripped since they were reset.
34. The safe run switch is in the run position.
35. The local remote selector is in the position for the desired operation. If the selector is in the local position, the amber permissive light will not be received at the controlling location.

Operating the starting switch then performs the following functions immediately.

1. Starts the sequence timer.
2. Starts the auxiliary lubricator motor.
3. Starts the auxiliary lube oil pumps. (The auxiliary lubricator motor and the auxiliary lube oil pump shut off when the lube oil pressure reaches 30 pounds.)
4. Pressurizing valve begins to open.
5. Vent valve starts to close as soon as pressurizing valve is fully open.
6. After vent valve has closed and five minutes have elapsed since the start of the sequence, the discharge valve begins to open.
7. After the discharge valve begins to open, the pressurizing valve closes.
8. As soon as discharge valve is open, starting air and jet air are admitted to the engine and turbo supercharger, respectively. (Starting air is turned off at 6" of Mercury. Turbine air is turned off at 9" of Mercury.)
9. When engine reaches speed of 75 rpm with a scavenging air pressure of 1" of Mercury or over, the ignition is turned on.
10. Fuel gas is now admitted to the engine.
11. The engine fires and comes up to idling speed and remains at that speed until additional permissive conditions are met.
12. Should the discharge gas temperature reach set point, the suction valve will begin to open; however, normally the suction valve does not open until the timer has timed for 10 minutes, the scavenger air has reached 9" of Mercury, and the lube oil and water jacket temperatures have reached a permissive set point.
13. When the suction valve is completely open, the recycle valve begins to close. When the recycle valve is closed, the engine is ready to load.

FIGURE 1—Here slack is being taken out of the main pull cable as the first 360-foot section of Socony's new 8-inch products line crossing is threaded into the west end of the company's damaged 12-inch products artery under the Delaware. Pull cable for the 6,300-foot crossing was 1½-inch steel wire rope. Except for damage caused by a ship's anchor in the river channel, the "casing" pipe is in excellent shape.

Socony Pulls 8-Inch Through Damaged 12-Inch Under Delaware River

Crossing wins $150,000 gamble on pipe-within-a-pipe construction job. Fuel oil pumped into annulus "lubricated" pipe walls during the pull

By H. T. Brundage
PIPE LINE INDUSTRY Staff

IN THE MANY years that pipeliners have devoted to getting a string of pipe across a stretch of water, engineers and contractors have devised some ingenious methods. Few have been more unusual than that used recently by Socony Mobil Oil Company and Missouri Valley Dredging Company to lay an 8-inch products line under the Delaware River near Philadelphia. Socony has two other products lines, a 10-inch and an 8-inch, crossing at this point; the new "8-inch in the 12" will serve as an emergency standby.

More than 6,300 feet of 8-inch pipe was pulled through the damaged 12-inch line previously laid below the river bottom. First, a repair coupling was installed to restore the damaged section of 12-inch ruptured in February by a ship's anchor. Then a pig was pushed through the old line with air pressure, threading a cable which was later used to string the 1½-inch steel pulling cable. After purging and drying the old line with two pigs separated by an alcohol slug, the standby 8-inch line was pulled through. To lubricate pipe walls and reduce drag during the pull the annulus was filled with fuel oil.

Maximum depth of the river channel opposite Socony's Paulsboro, N. J., refinery is 49 feet below mean low tide; the damaged portion of the line had been buried in silt below the channel floor at a minimum depth of 56 feet. Divers used an underwater cutting torch to remove the damaged ends of the break; a repair coupling was installed and the pipe realigned and restored to hold air pressure up to 80 psi.

Late in the summer, advanced preparations for installing the new crossing got underway. To get a pig through the line, Mobil engineers designed a system to force it through the damaged 12-inch from the Paulsboro side by air pressure. It threaded a quarter-inch cable inside the existing line by means of a specially designed cable guide and the seal made up of a

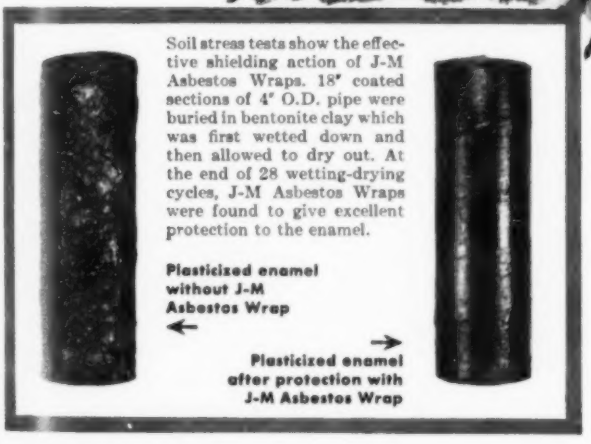
FIGURE 3—Fuel oil was pumped into the 12-inch line after it was purged and dried with an alcohol slug between two pigs. More than 15,000 gallons of No. 4 fuel oil, with corrosion inhibitor added, provided buoyancy to the 8-inch string reducing drag during the pull.

FIGURE 2—A ¼-inch cable was threaded through this sealing gland supported by a blind flange with three welded gussets. To make the gland, a 15-inch piece of shafting was bored slightly larger than the threading cable. A pressure grease fitting permitted lubrication of the cable, reducing loss of air pressure behind the pig.

FIGURE 4—Main pulling cable makes a right angle turn through deadman anchored pulley on Paulsboro side. Pulling cable from 100-ton winch, shown slack in the foreground, was clamped onto the main cable to take it in as each new 36[illegible]-foot section was completed. More than 6,300 feet of 8-inch w[illegible] threaded through old line from launching point across river.

Stop damage to enamels from earth loads and soil movement . . .

Johns-Manville Asbestos Wraps are available in 3 types for field application or mill wrapping.



Soil stress tests show the effective shielding action of J-M Asbestos Wraps. 18" coated sections of 4" O.D. pipe were buried in bentonite clay which was first wetted down and then allowed to dry out. At the end of 28 wetting-drying cycles, J-M Asbestos Wraps were found to give excellent protection to the enamel.

Plasticized enamel without J-M Asbestos Wrap ←

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Get lasting protection with tough, strong J-M Asbestos Wraps

Extensive research and field tests conducted by a leading firm of consulting engineers have demonstrated the effects of soil movement and earth loads on pipeline enamels. They show how the forces of the soil tend to distort and induce thin spots that weaken the protective coating . . . permit corrosion of the pipeline.

The same research and field tests also demonstrated that J-M Asbestos Wraps provide the strong protection that strong coatings need and deserve. "Asbestos Wraps offer the most effective single protection against damage—prolong the working life of pipeline enamels." Here's why . . .

Asbestos is an ageless mineral. Fibers of asbestos are strong and tough . . . cannot rot or decay. As used in J-M Wraps, the fibers are felted, then impregnated with a coal tar or asphalt saturant to form literally a flexible covering of stone. These "stone-like" qualities form a durable shield—protect pipeline enamels from earth loads and soil movement which weaken coatings and permit pipe corrosion to set in.

Pipeline engineers are invited to write for their own copy of PP-34A, a *3-Point Study of Pipeline Coatings and Wrappers*, at no cost or obligation.

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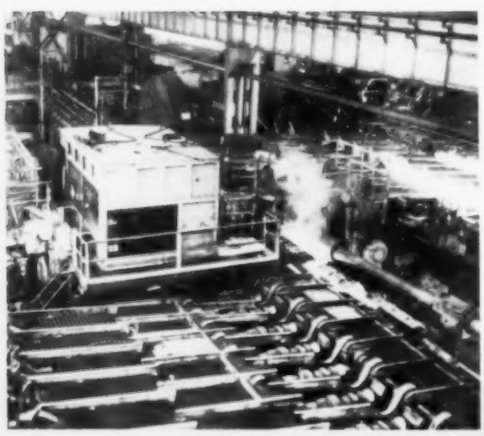
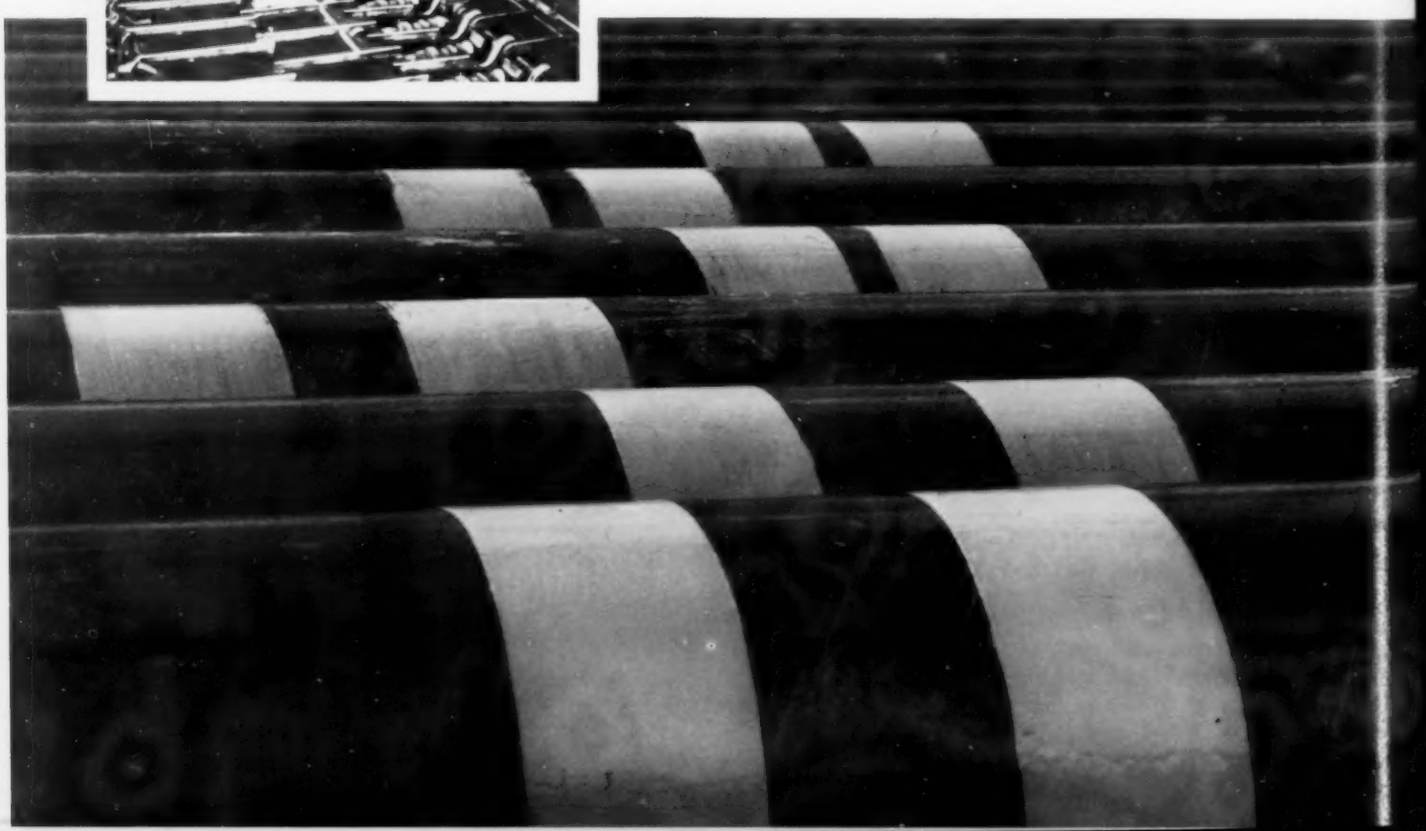


Youngstown's ultra-modern, fully-automated No. 3 Seamless Mill —now operating at our Indiana Harbor Works near Chicago— turns out the pipe with the orange bands, the finest made anywhere. Illustrated is the piercing operation at which point a hole is made down the middle of a solid round steel billet. Here is where Youngstown's quality and dependability is built into the pipe with the orange bands.

THE YOUNGSTOWN SHEET AND TUBE COMPANY *Youngstown 1, Ohio*



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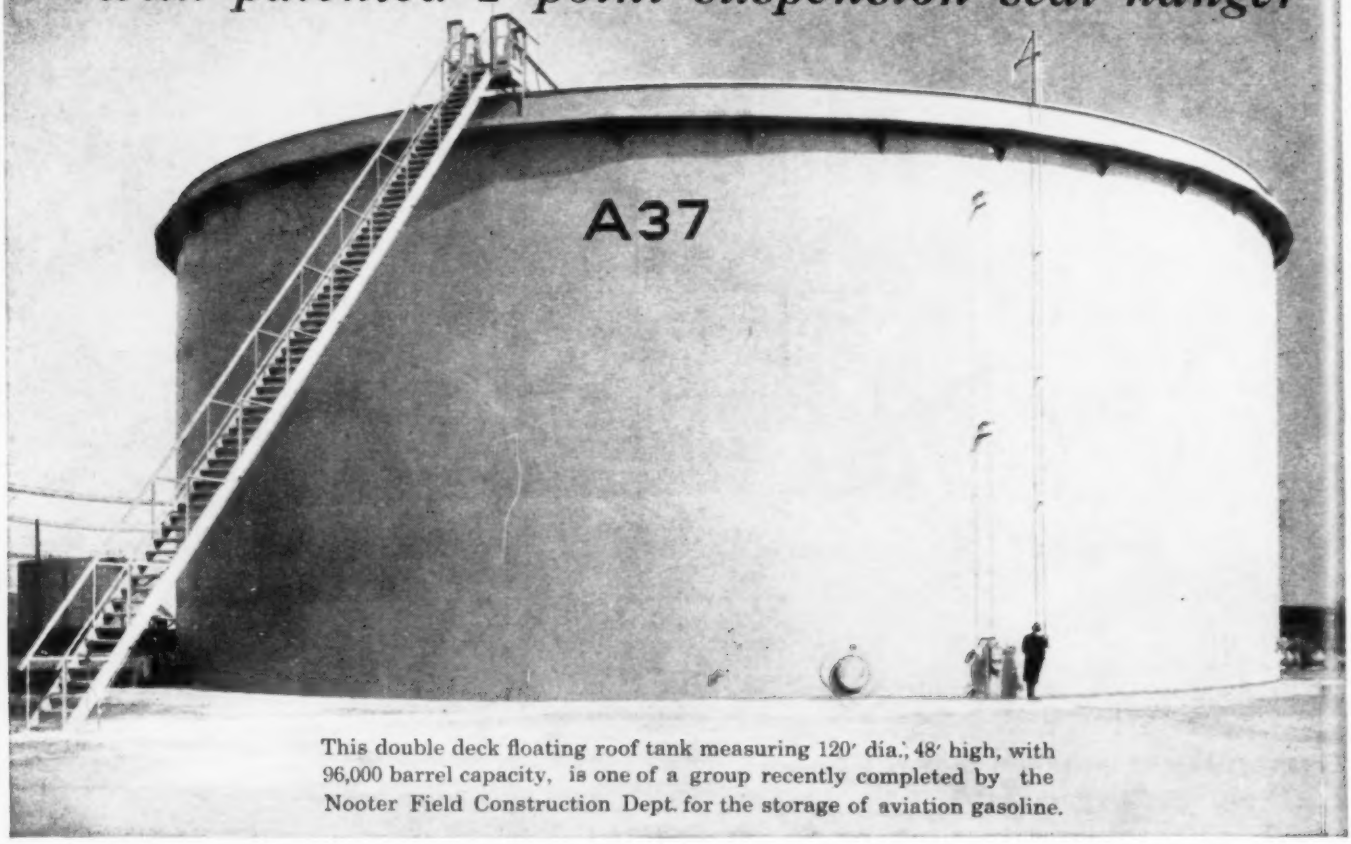
new floating roof tank

with patented 2-point suspension seal hanger



This double deck floating roof tank measuring 120′ dia., 48′ high, with 96,000 barrel capacity, is one of a group recently completed by the Nooter Field Construction Dept. for the storage of aviation gasoline.

The floating roof oil and gasoline storage tanks fabricated and erected by Nooter are now distinguished by the new patented Nooter seal.

Because this seal exerts a uniform outward pressure over the entire height of the sealing shoe, a better seal is achieved, and abrasion at any one point is reduced.

Another important feature of the seal: all operating mechanism is placed beneath the roof, leaving the deck clear and neat.

The Nooter seal is adaptable, without size limitation, to double-deck, pontoon and pan-type roofs, or any existing type of floating roof.

For complete information on how the new Nooter floating roof tank can serve you better, write or call Nooter today. No obligation.

new NOOTER SEAL design offers you:

- A simpler, more effective seal.
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1 ¼-inch gland supported by gussets and welded to a blind flange. A 15-inch length of shafting was bored slightly larger than the quarter-inch cable to make the guiding gland; a Zerk fitting installed near the flange was used to lubricate the cable and reduce air loss during the threading operations.

Two pigs were then forced through the old line by 50 psi air pressure; they were spaced 33 feet apart. A slug of alcohol between them helped to dry out the pipe. The pigs purged out any remaining contaminated product and water.

After the pigs had completed the cleaning step a ⅞-inch cable was attached at the Paulsboro side and pulled through; then a 1½-inch cable was secured to the ⅞-inch messenger and pulled through for the main pulling operation.

Seamless 8⅝-inch O.D., 28.55-pound line pipe was welded in 360-foot strings on the west bank in preparation for the pulling phase. Because of limited working space on the river bank it was necessary to weld up 18 such sections. Welds were radiographed and films were developed and examined at the site.

Fuel Oil Lubricated Pipe Walls. To provide lubrication and reduce friction by buoyancy effect between the 12- and 8-inch strings, the large pipe was partially filled with No. 4 fuel oil. Oil-soluble inhibitor was added to reduce possible corrosion.

'Stopper' Cable Attached to Each New String. Pipe was pulled by a 100-ton winch, anchored on the Paulsboro side of the river. As each section of pipe was stovepiped on, a secondary cable attached to the winch was clamped onto the main 1½-inch pulling cable; this reduced the hazard of a fishing operation in case the cable were to part.

A tension of about 45 tons was applied at the Paulsboro side during the initial 4,500 feet of pulling operations. A dynamometer on the pulling winch indicated the amount of tension developed.

Tractor 'Push' Assists. The crossing proceeded smoothly until about 4,500 feet of pipe had been pulled; then the string became stuck temporarily. The auxiliary cable attached to the pulling unit was parted when tension was applied in an attempt to loosen the 8-inch pipe string.

More force was needed to free the pipe of the damaged area and pull it up the incline to the Paulsboro side. On the Philadelphia side of the river, a clamp was put on the 8-inch pipe, and a cable was strung along the ground toward the river. A tractor pull on the cable provided a "push" from the west bank. Dynamometer readings indicated that about 20 tons of force was thus added to the 50 tons of winch pull from the east bank. In this way the crossing was completed in less than three days after the start of the pull. —**The End**

FIGURE 5—The 8-inch pipe was welded up in 18 360-foot sections because of the limited working space on the west bank of the river. Here welders line up and run stringer bead as a new section is stovepiped during the pull.

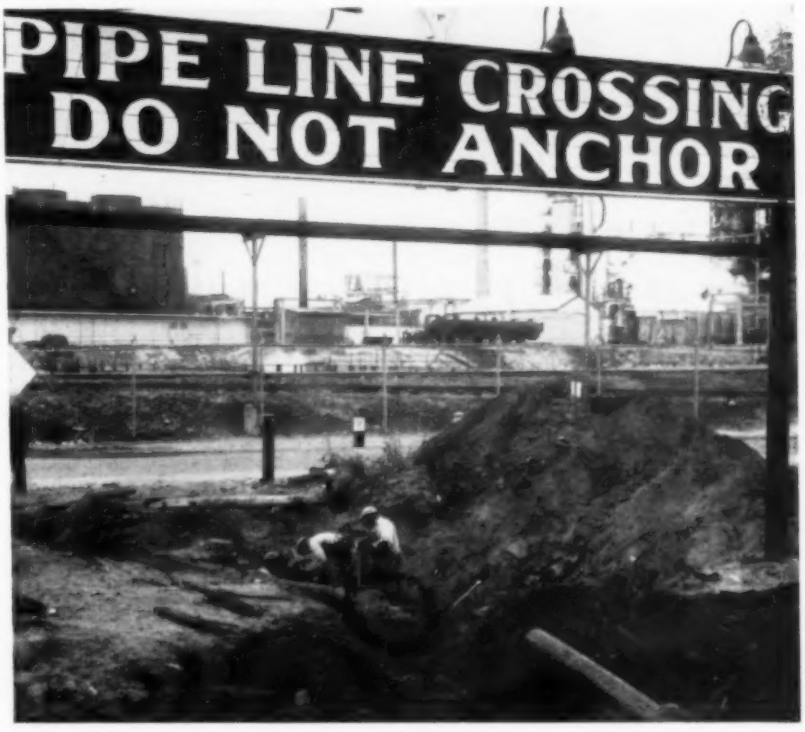
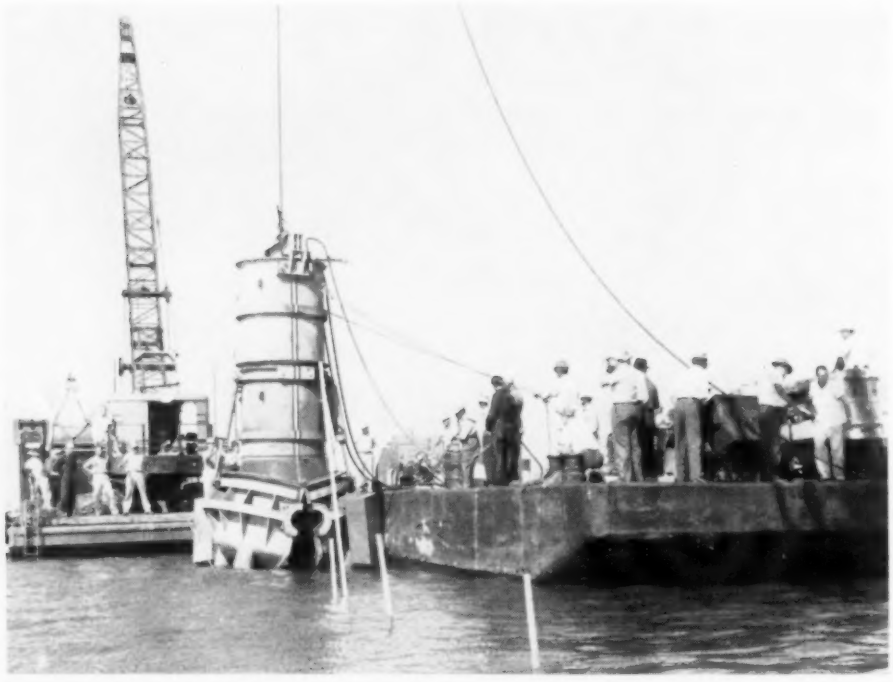


FIGURE 6—Job nears completion as lead end of 8-inch extends from its 12-inch "casing;" tie-in crews make connection to Socony's Paulsboro, N. J., refinery terminal. The new line will serve as an emergency standby. Operations were finished just three days after the start of the pull.

WHAT'S HAPPENING

IN PIPE LINE CONSTRUCTION

By Donald G. DePugh, PIPE LINE INDUSTRY Staff



Interstate's Pipe Line Caisson Lowered Into Water

Interstate Oil Pipe Line Company's underwater pipe line repair caisson is lowered over a pipe in Barataria Bay off coast of Louisiana. Stakes in foreground point out location of the line. The caisson clamps around the pipe and is held down by heavy weight blocks on extreme left and right of the caisson. Hydraulic rams, above the weights, are used to open and close the caisson in clamping around the pipe. Pipe on top is discharge line for pumping water out of caisson after it is placed in position.

Interstate Introduces Improved Caisson For Underwater Pipe Line Repair Work

Interstate Oil Pipe Line Company recently made a successful field test of a new caisson for repairing or making hot taps on pipe lines under water. Working on a 12-inch crude line in Barataria Bay near Grand Isle, La., the caisson was lowered seven feet under water and completed the initial tap and connection in one day.

Previously, repairs and connections to underwater lines have been made either by raising the line above water or by using a caisson which proved unsatisfactory.

The new caisson, designed for pipe from 2 to 20-inch, can be used for submerged repair work in water up to 50 feet. After preliminary preparations of staking the location and clearing mud from around the line, the caisson was lifted by crane from a barge and lowered over the pipe. The bottom of the caisson, which is seven feet in diameter, was clamped around the pipe by means of hydraulic rams; water was then pumped out of the caisson by a sump pump. To get to the pipe workmen descended a ladder inside the caisson to a deck over the line.

Top sections of the caisson extend six to 12 feet in length and five feet in diameter; the number of top sections used depends upon the depth of the water. A continuous neoprene rubber sleeve connects bottom and top parts of the caisson and permits opening and closing of the bottom bell section around the pipe.

Hydraulic power is supplied to the rams by a pumping unit located on the barge and connected to the rams by a hose.

The repair unit weighs approximately 16,000 pounds; as many as 12 weights, 3,900 pounds each, can be attached to the bottom section to overcome buoyancy for work in deeper water.

Development of the caisson was undertaken by Interstate as a joint project with Esso Research and Engineering Company. William Lacy, Interstate mechanical consultant, made the initial study and design of the improved caisson.

Coastal Awards Contracts On 168 Miles of Gas Lines

Coastal Transmission Company has awarded contracts to Oklahoma Contracting Company and O. R. Burden Construction Corporation for construction of 168 miles of 6, 12 and 14-inch gas lines in Texas and Louisiana.

Coastal will lay 40 miles of 14-inch, 25 miles of 12-inch, and 13 miles of 6-inch from near Port Allen to a point near Donaldsonville, La.

Burden has contract for 90 miles of 12-inch starting near Faysville running northeastward to a point near Robstown, Texas.

This is the second contract awarded Oklahoma by Coastal for construction on its 574-mile gas line from McAllen, Texas to Baton Rouge, La. Coastal is laying 127 miles, 24-inch, main line in Louisiana and 150 miles, 26-inch, main in Texas.

Coastal project is part of the Texas to Florida line. Houston Texas Gas and Oil Corporation, which is building the Baton Rouge to Miami section, has awarded a contract to the Kendall Company to tape wrap the entire 920 miles of main line from Baton Rouge to Miami, Fla. The $3 million job marks the first time a major system has been completely wrapped with tape.

Houston Contracting Co. Awarded Three Contracts

Houston Contracting Company has been awarded contracts by Texas Gas Transmission Corporation and Texas Eastern Transmission Company to construct about 64 miles of gas lines in Louisiana.

Texas Gas spreads include 12 miles of 16-inch southwest from Eunice and 3 miles of 30-inch in the vicinity of Pineville, Rapides Parish.

Houston will lay 22 miles of 14-inch for Texas Eastern in Acadia Parish. Texas Eastern also awarded a contract to Midwestern Contractors of Ohio, Inc. to lay approximately 9 miles of 8-inch pipe in Ohio.

Cities Service Authorized To Construct 106 Miles

Cities Service Gas Company was granted Federal Power Commission authorization to construct approximately 106 miles of various diameter lines in Montgomery, Allen, Anderson, Franklin, Miami, Johnson and Wilson counties, Kansas.

Cities Service will also add 3,600 horsepower to its Blackwell compressor station in Kay County, Okla., and will abandon and reclaim 185 miles of varying diameter pipe between its Grabham station in Montgomery County and Kansas City, Mo.

Pacific Lighting Gets Approval for Gas Line

California Public Utilities Commission has given approval for construction by Pacific Lighting Gas Supply Company to build a 128-mile, 34-inch gas line.

The $18.6 million line will extend from the California border near Needles to Newberry, Calif. The line will tie in with Transwestern Pipeline Company's proposed 1,035-mile line from Texas-Oklahoma Panhandle areas to Needles.

Initial capacity of the Pacific Lighting line will be 300 MMcf daily.

Kerr-McGee Purchases Magnolia Crude Lines

Kerr-McGee Oil Industries, Inc. purchased 51 miles of main line and 75 miles of crude gathering lines in Oklahoma from Magnolia Pipe Line Company.

The 5- to 8-inch trunk lines are located in Garvin, McClain, Cleveland, Pottawatomie, Seminole counties. The line runs from Maysville to Wewoka.

The gathering portion is located in Pottawatomie, Seminole, Hughes, and Okfuskee counties. The system gathers 3,000 barrels of oil daily.

Transcontinental Gas Pipe Line Plans Second Loop Line From Texas to New York

Transcontinental Gas Pipe Line Corporation is planning to build a second loop line parallel to the company's 2,000-mile trunk line from south Texas to New York.

Transco took the first step in its long range plan last month by filing an application with the Federal Power Commission seeking permission to construct $51 million of additional facilities to be built in 1959.

This project will add the first segments on a third line paralleling Transco's previously looped line from Texas to New York.

Facilities proposed in the application include 149 miles of 36-inch main loops; 34 miles of 20 and 24-inch gathering laterals; new compressor stations in Nueces County, Texas, and St. Helena Parish, La.; and additional compressor horsepower in eight of the 25 existing main line stations. The new facilities will enable Transco to provide an increase of 82 MMcf of gas daily for customers plus an increase of 8 MMcf per day transported for Sun Oil Company.

Total daily allocations will be 1,281 MMcf and 1,621 MMcf per day including gas from storage.

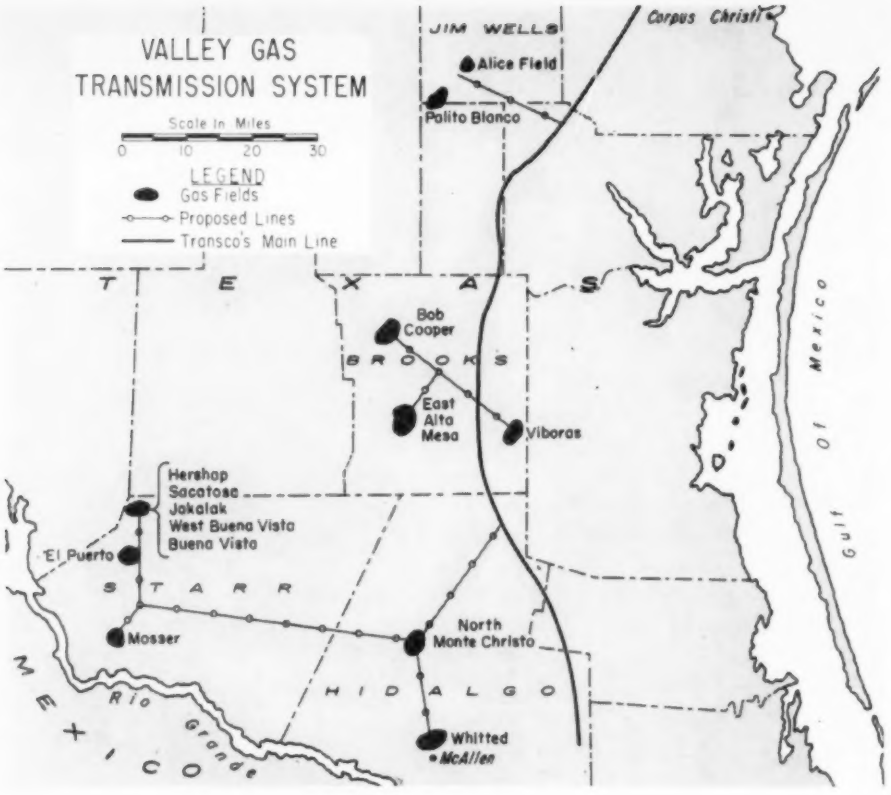
Main line loops will be spread over four states. Transco will lay 6 miles in Louisiana, 27 miles in Mississippi, 14 miles across Mississippi-Alabama border, 58 miles in Alabama, 25 miles crossing the Alabama-Georgia border and 20 miles in Georgia.

Gathering lines will consist of 20 miles of 20-inch offshore work in Block 76 off Vermilion Parish in Louisiana, and 12 miles, 24-inch, purchase lateral loop in the Cameron, La. area. The expansion program includes 16 miles of 20-inch from Marcus Hook, Penn. to Woodbury, N. J., including a crossing of the Delaware River.

Transco presently is undergoing construction of 673 miles of main loops, gathering and lateral lines, which will be completed by 1959.

Final Weld on Trans-Canada Pipe Line

The final weld on Trans-Canada Pipe Lines Limited 2,294 mile gas line was made near Kaspuskasing, Ontario, October 10. Final testing of the line was completed by October 22, and the approval from the Board of Transport Commissioners for Canada was received. The line extends from Alberta to Montreal and was constructed over a period of two years. The 852-mile section from Port Arthur, Ontario, to Toronto was constructed in 1958.



Valley Gas Transmission, Inc., Plans $15 Million Gathering System in Texas

Fish Engineering Corporation has formed a subsidiary, Valley Gas Transmission, Inc., to build a $15 million gas gathering system in south Texas. Transcontinental Gas Pipe Line Corporation has been contracted to transport the gas from Texas to the Long Island Lighting Company in New York.

Valley has filed with the Federal Power Commission for approval to take gas from 15 south Texas gas fields and sell to Long Island Lighting. Fields are located in Hidalgo, Brooks, Starr, and Jim Wells counties.

The system will consist of approximately 160 miles of 3 to 8-inch lines which will tie-in with Transco's main line at points in Hidalgo, Brooks and Kleberg counties. Valley plans to begin construction in December and complete 100 miles of the system by January 15 to deliver 17.5 MMcf daily to Long Island.

The remainder of the project will be laid by next summer, giving Valley a capacity of 100 MMcf of gas daily. Starting in January 1960 Valley will deliver 32.5 MMcf to Long Island; other customers will be sought for the additional gas.

There is a widely discussed possibility that Fish will import gas from Mexico to supply northeastern customers. Gas would be received from Petroleum Mexicanos in the McAllen area.

211-Mile Crude Line; NATO Project in Turkey

NATO announces bids are being asked on a 211-mile crude line in Turkey. The 6-inch line will be constructed between Malatya-Cetinkaya-Erzincan.

Pipe for the $6 million project, except for about 34 miles of heavy wall thickness pipe, will be furnished by the Turkish Ministry of Public Works.

Iran Oil Company Awards Contract on 218-Mile Line

Iran Oil Company has awarded a contract to B&M Construction Corporation to build a 218-mile, 8-inch crude line from Teheran to the company's facilities near Rescht on the Caspian.

The $10 million project is expected to be completed by October, 1959. Contract calls for construction of five stations and a small amount of lines within the company's tank farm.

Canadian Companies Propose Joint 36-Inch Gas Pipe Line

Westcoast Transmission Company and Alberta and Southern Gas Co., Ltd., plant a joint project calling for construction of a 36-inch gas line from the Alberta border through Crowsnest Pass to the British Columbia-Idaho border at Kingsgate.

The two companies claim that the $40 million large diameter line used jointly would be more economical than two smaller lines.

The line will be owned and operated by Alberta Natural Gas Company, in which both companies will have equal stock interest.

Alberta and Southern Gas Company will supply gas to California markets and Pacific Gas & Electric Company, which is planning a line from Canada to California. Westcoast will make gas available to communities in British Columbia and Pacific Northwest Pipeline Corporation.

Colombian Petroleum Co. Plans 68-Mile Crude Line

Colombian Petroleum Company will lay a 68-mile, 12-inch line to carry crude from Cicuco field to the Covenas terminal on the Caribbean. Construction is scheduled to start in 1959. Initial capacity of the line will be 36,000 barrels daily. It will parallel a 12-inch running from the Barco concession past Cicuco to the sea.

Pacific Northwest Lets Contract on 11-Mile Line

Mid-Mountain Contractors, Inc., will lay 11 miles of 4-inch lateral line in Klickitat County, Washington for Pacific Northwest Pipe Line Company.

Mid-Mountain will also construct a ½-mile in Wasco County, Oregon.

Pemex Begins Work On 500-Mile Line

Petroleos Mexicanos has begun construction on a $40 million, 600-mile gas line from Tabasco to Mexico City. The 24-inch line which will deliver 300 million cubic feet of gas daily to industrial consumers along the line and in Mexico City.

Pemex is nearing completion on its 108-mile, 10-inch, gas line from Monterrey to Moncolva.

PROPOSED PIPE LINE CONSTRUCTION

Here in convenient summary form is Pipe Line Industry's listing of company, line size, length, service, location and project status.

U. S.

American **Louisiana Pipe Line Co.**, Detroit, two 12,000 hp compressor stations in Ohio and Indiana; additional 2,000 hp at existing stations in Mississippi and Tennessee; 3 miles pipe line, meter station in Cameron, La., $7 million, FPC authorization.

Chicago District Pipeline Company, 52 miles, 30-36 inch, gas, from Natural Gas' proposed line at Joliet to Chicago, $13 million, before FPC.

Cities **Service Gas Company**, Oklahoma City, 106 miles, gas, gathering, in Montgomery, Allen, Franklin, Miami, Johnson, and Wilson counties, Kansas, 3,600 hp to Blackwell station, Kay County, Kansas, FPC authorization.

Coastal States Gas Producing Co., Corpus Christi, Texas, 45-mile, gas gathering system in Bee County, Texas to connect with Texas Eastern's main pipe line, $1 million, planned.

289 miles, 14 and 18-inch main line and gathering system, McAllen to Falfurrias, Tex., area, and Lopena to La Salle County, $12 million, planned.

Coastal Transmission Corp., Houston, 574 miles, 22-24 inch, gas, from McAllen, Texas to Baton Rouge, La. connection of Houston, Texas Gas and Oil plus 414 miles of laterals, $55 million, contracts let on compressor stations to Gasoline Plant Construction Corp. Contract let on 443 miles, main and laterals, to Oklahoma Contracting Co., and O. R. Burden Construction Corp.

Colorado Interstate Gas Co., Colorado Springs, 140 miles, gas, main, Salt Lake City to Rock Springs, Wyo., planned.

Conn-Mass Pipe Line, Inc., Orange, Conn., 38 miles, 8 inch, products, from Boston to Springfield, Mass., considered.

133 miles, 16-inch, products, from Linden, N. J. to Hartford, Conn., considered.

62.2 miles, 8-inch, products, from New Haven, Conn. to Springfield, Mass., considered.

38 miles, 6-inch, products, from Waltham, Mass. to Fitchburg, Mass., considered.

Consumers Power Co., 45 miles, gas, main line, from Woodbury station to Laingsburg Junction, Mich., planned.

126-miles, 26-inch, gas, main, Michigan-Indiana border to Plymouth, Mich., planned.

El Paso Natural Gas Company, El Paso, 216 miles, 26 to 34-inch main line, 533 miles, 6-20-inch laterals, gas, 86,750 compressor hp; 126 miles, 30-inch main line, 266 miles, laterals, gas, 28,920 compressor hp in new and existing stations in Arizona, New Mexico and Texas, contracts let on 819 miles to R. H. Fulton & Co., McVean & Barlow, Inc., Western Pipe Line, Inc., Eastern Pipeline Contractors, and Engineers Limited Pipeline Co.

400 miles, 34-inch, Salt Lake City, Utah, to California border, planned.

Emerald Pipe Line Corp., 195 miles, 6 inch, products, from Tucumcari, N. M., to Albuquerque, N. M., contracts let to Arey Pipe & Construction Co., Inc., and Groninge & King, Inc.

Equitable Gas Company, Pittsburgh, Penn., 11.7 miles of storage pipe line and other facilities, $2,091,430, authorized.

Everglades Pipe Line Company, Miami, Fla., 35 miles, 10-inch, products, Port Everglades to Miami International Airport, $2.5 million, planned.

Gillette Pipeline Co., Cheyenne, Wyo., 103 miles, crude, from Dead Horse Creek field to Casper, Wyo., planned.

Great Northern Railway, St. Paul, 400-600 miles, 12-20 inch, crude, from Williston Basin to St. Paul-Minneapolis and Duluth-Superior areas, considered.

Gulf Interstate Gas Co., Houston, 12.8 miles, 6 and 20 inch, gas, loop line in Louisiana, $730,000, authorized.

Gulf Pacific Pipe Line Company, 1,600 miles, 30-inch, gas, Louisiana to California border, considered.

Gulf Resources, New York, 125 miles, gas, gathering system, from Lopena area in Zapata County to a point in La Salle County, Texas, planned.

Humble Oil & Refining Co., 250 miles, 26 or 30 inch, gas and 116 miles, main gathering system, varying sizes, from southwest Texas to Houston, plus gas processing and cycling plant near Corpus Christi, $75 million, planned.

Interstate Oil Pipe Line Co., Shreveport, La., 35-miles, 6 and 8-inch, crude, Brookhaven to Gwinville, Miss., contract let to Ford, Bacon & Davis Construction Corp.

Iron Ranges Natural Gas Co., 115 miles, gas, from Itasca and St. Louis counties along route of Mesabi range from Grand Rapids to Aurora, Minn., $5 million, before FPC.

Jayhawk Pipeline Co., 140 miles, 6-inch, crude, from Meade County to Haskell and Morton counties, $2 million, contracts let to Engineering Construction Co. and R. H. Fulton & Company.

Katy and New York Central Railroads, 2500-mile, 10-12 inch, LPG, from Houston, Texas, to New York, considered.

Manufacturers Light and Heat Co., Pittsburgh, Penn., 21-miles, gas facilities in Pennsylvania and West Virginia, $1 million authorized.

34-miles, 20-inch, in Greene, Adams, and York counties, Penn., authorized.

Michigan Gas Storage Co., Jackson, Mich., gas, facilities in central Michigan, $2 million, authorized.

Michigan Wisconsin Pipe Line Co., Detroit.

621 miles, gas, 14,280 additional hp, $32 million, appeal before FPC.

20.5 miles, 24-inch, main line loop in Michigan, before FPC.

Midwestern Gas Transmission Co., Houston, 2067 miles, 3—24-inch, gas, from Emerson, Manitoba to Portland, Tenn., $111 million before FPC.

Mookl Chemical & Gas Corp., Tulsa, and **Missouri Transmission Corp.**, Springfield, Mo., 425 miles, 16-inch, gas, from Oklahoma City area to St. Louis, before FPC.

New York State Natural Gas Co., Pittsburgh, 30 miles, 20-inch, gas, main, Silver Springs to East Elma, N. Y., $1.6 million, temporary FPC authorization.

North Carolina Natural Gas Corp., 630 miles, 2-16 inch, from Transco's system near Mooresville across to southeastern North Carolina, $30 million contracts let on 200 miles to C. N. Flagg & Company.

Northern Illinois Gas Company, 140 miles, 24-inch, gas, main line, East Dubuque to Des Plaines, Ill., planned.

Northern Natural Gas Co., Omaha, 167 miles, 20 inch, gas, from Farmington, Minn. to Duluth, Minn., and Superior, Wis., $12 million, before FPC.

42 miles, 10 inch, gas, from Rochester, Minn. to Winona and Goodview, Minn., $963,000, before FPC.

365 miles, gas, new facilities in Minn., Iowa, S. D., Neb., Wis., plus 1090 miles of branch line and station facilities, $65.7 million, authorization for a part. Gas facilities in Texas, Oklahoma and Kansas, $6 million, before FPC.

454 miles, main line loops and extensions, 6-30-inch, main line from St. Cloud, Minn., to Grand Forks, N. Dak., also 1,490 miles of branch lines, 2-10-inch, and station additions totaling 32,000 horsepower, $86 million, planned.

27.6 miles, 30-inch, gas, loop; 18.3 miles north of Beaver station in Okla., 9.3 miles north of Sunray station in Texas, $3 million, authorized.

Northern Utilities Co., 35 miles, 16 inch, gas, in Fremont Natrona County, Wyo., area; 8 miles, 12 inch, around Casper; 6 miles, 8 inch, from Sand Draw gas field to Beaver Creek field; 12 miles, 6 inch, from Beaver Creek field to the system servicing the Riverton-Lander area, planned.

Ohio Fuel Gas Co., 51 miles, gas, main lines, in Belmont, Carroll, Cuyahoga, Fairfield, Logan, Lorain, Marion, Muskingun, Stark and Wayne counties, Ohio, $2.2 million, authorized.

Natural gas storage field in Medina County, Ohio, 12 miles, 4½ to 20-inch, gas, $5 million, authorized.

Pacific Gas & Electric Co., 1300 miles, 30-inch gas, from Alberta, Canada to Antioch, Calif., $380 million, planned.

Pacific Lighting Gas Supply Co., 128-mile, 34-inch, gas, main line from Topock, Ariz. to Newberry, Calif., authorized.

Pacific Northwest Pipeline Corp., Salt Lake City, 235 miles gas, gathering lines in San Juan Basin, Garmesa, Piceance Creek, and Big Piney Fields, $13.5 million, planned.

65 miles, gas, sales laterals in Washington, $1.5 million, planned.

Pennsylvania Gas Co., Warren, Penn., 38 miles, 8 and 10 inch, gas, in Erie and Warren Counties, Penn., and Chautauqua County, N. Y., $2.6 million, authorized.

Permian Basin Pipeline Company, Omaha, 61 miles, 16-inch, lateral, gas, 11 miles, various diameter, field lines, nine meter stations, to take gas from Emperor field, Winkler County, Texas, $3.7 million, FPC authorization.

Piedmont Gas Co., Hickory, N. C., 78 miles, 2-8 inch, gas, from connection with Transcontinental Gas Pipe Line to serve customers in North Carolina, $2.6 million, authorized.

Pioneer Natural Gas Co., Amarillo, Texas, 62 miles, 10-inch main, Pampa, Texas, to Canyon, in Randall County, Texas, 20 miles, small diameter, gathering, 4,000 h.p. stations, $4.5 million, planned.

Phillips Petroleum Co., 25 miles, 6 to 20-inch, gas, South Eunice, New Mexico area, planned.

52 miles, 4 to 20-inch, gas, Gaines County, Texas, planned.

44-mile, 6-inch, products line, from Rocky pump stations to Amarillo, Texas, planned.

Plantation Pipe Line Company, 48-mile, 4-inch, products, between Bremen and La Grange, Ga., $1 million contract let to Nichols Construction Co., Inc.

Service Pipe Line Company, Casper, Wyo., 4,000 compressor hp at Herndon, Kans., 2,000 compressor hp at Scranton, Kans., and 2,000 compressor hp at LaGrange, Wyo.; additional 2,000 hp at Laton station, Rocks County, Kans., 2,200 additional hp at Elk Basin, Kirby, Owl Creek, and Lost Cabin stations, north of Casper, Wyo., planned.

Shell Pipe Line Corp., Houston, 100 miles, 18-20 inch, crude, Southwest Pass to Norco Refinery near New Orleans, $10 million, contract let to Houston Contracting Co., Glaser Construction Co., J. Ray McDermott & Co., Delta Engineering Corp., and Station Construction Co.

43 miles, 8-inch, crude, main, and 20 miles, crude gathering, Colorado City, Texas, to Borden-Garza County of West Texas, planned.

Southern Kansas Pipe Line Co., Inc., Arkansas City, Kansas, 200 miles, 6-10 inch, crude, southwestern Kansas to Arkansas City, Kansas, planned.

Southern Natural Gas Company, Birmingham, 136 miles, 24 and 26 inch; 215 miles, various diameter supply lines; 3,650 additional compressor horsepower to White Castle and Toca Stations; 8 miles, contract let to Conner Construction Co., 20-inch loops; 660 hp Franklinton station, and 23 measuring stations. $40 million, contracts let to William Brothers, Western Pipe Line, Inc., Brown & Root, Inc., and River Construction Corp. on 305 miles.

458 miles, 16-24-inch, loop lines, gas, between Gwinville, Miss., and Wrens, Ga.; 62 miles, 14-inch, loops, along Atlanta-Macon line; 53 miles, 6⅝ to 14-inch, loops, along various branch lines. 3,140 additional hp at Gallion and Elmore, Ala. and Wrens, Ga. 60 miles, 20-inch, loops, in Louisiana between Franklinton and White Castle and South of Toca. Lateral lines south of Gwinville and west to Cranfield field, 8,720 hp added at Franklinton, White Castle, Patterson and Brookhaven. $65 million, contracts let to River Construction Corp., H. C. Price, Latex Construction Co., and Houston Contracting Co. on 355 miles.

Tennessee Gas Transmission Co., Houston, 264 miles loop lines in Tennessee, Kentucky, West Virginia and Pennsylvania, FPC Examiner authorization.

Compressor stations in Mississippi, Tennessee, New York, Pennsylvania and additions in Tennessee, Kentucky, Ohio and Pennsylvania, $129 million, FPC Examiner authorization.

21 miles, 16-inch, 2 miles, 12¾-inch, gas, Louisiana coast, Vermillion, Blocks 46 and 64, $2.9 million, before FPC.

Texas Eastern-Penn-Jersey Transmission Corp., Shreveport, La., 65 miles, gas, from Delmont, Penn., to Lambertville, N. J., before FPC.

24,000 compressor hp additions to existing stations, $4.4 million, temporary FPC authorization.

4,000 horsepower to its Delmont, Penn., compressor station, five new compressor stations in Pennsylvania with total capacity of 67,000 hp, $11.2 million, authorized.

Texas Eastern Transmission Corp., Shreveport, La., 267 miles, 14-30 inch, gas, Louisiana, Mississippi, Pennsylvania and New Jersey, $50 million, before FPC.

96.5 miles, 30-inch, gas, between Kosciusko, Miss., and Uniontown, Penn.; 9.4 miles of supply laterals; a 10,250 hp compressor station, and 33,360 hp to existing compressor stations, $24.5 million, authorized.

141,780 additional horsepower in existing stations, a new 2,200 hp compressor station, in Louisiana, Mississippi, Pennsylvania, Ohio, Kentucky and Tennessee, authorized.

10 miles, 8-inch, LPG, Lebanon to Todhunter underground storage in Ohio, 62 miles, 8-inch, Tyler to Carthage, Texas, planned.

Texas Eastern Transmission Corporation and Wilcox Trend Gathering System, Inc., gas, compressor stations, $4 million, authorized.

Texas Gas Gathering Corp., Shreveport, 36.6 miles, gas, gathering system in Rodney Field, Jefferson County, Miss. and from North and South Locust Ridge, Lake St. John Field in Tensas and Concordia parishes, La., $855,413, before FPC.

Texas Gas Transmission Corporation, Owensboro, Ky., 92 miles, 30-inch, 19 miles, 26-inch, and 15 miles, small diameter, loop portions of system in Louisiana, Arkansas, Mississippi, Kentucky, Indiana and Illinois; additional horsepower at Pineville, La., Kenton, Tenn., Calvert City, Ky., Slaughters, Ky., Dillsboro, Ind., and Petersburg, Ind., totaling 9,040 hp. $20 million, before FPC.

Texas Illinois Gas Pipeline Company, Chicago, 16,000 additional hp to stations at Lufkin, and Marshall, Texas; Texarkana, Malvern, Searcy, and Biggers, Ark.; Jackson, Mo.; and Hammond. Ill., $3.9 million, before FPC.

Transcontinental Gas Pipe Line Corp., Houston, 204 miles, 36-inch, 107 miles, 30-inch, main line loops in 10 states; 3 intermediate stations: North Carolina, Virginia, Pennsylvania; 2,500 additional hp at six compressor stations; 154 miles, 24-inch from Leidy storage Penn.; 29 miles, 30-inch, New Jersey; gathering lines, Louisiana, 119 miles; 10 meter stations; additions to West Cameron and High Island area, 35-miles, 16-inch, 26 miles, 10-inch, and three gathering meter stations; 45 miles, 16-inch, purchase laterals and 5 meter stations, Louisiana; 67 miles, 10, 12, 20-inch miscellaneous transmission purchase laterals in Texas and Louisiana, 3 meter stations; 51 miles, 36-inch and 1 mile, 30-inch in New Jersey; 51 miles, 0- and 14-inch and 3 meter stations, southeast Louisiana (mainly offshore), $137.3 million. Contracts let on 673 miles to Bechtel Corp., Charman, Allen, Gay & Taylor, Panama Williams, J. P. Neill, H. C. Price, Brown & Root, and Hallmac Construction Co.

151 miles, 24-inch, 12 meter stations, southeast Louisiana, $14.5, authorized.

2,500 additional hp at four compressor stations, St. Francisville, La.; Laurel, Miss.; Linden, Ala. and Wadley, Ala., $3 million, authorized.

Wells, pipe lines, measuring equipment, stations at Leidy storage in Pennsylvania, $12.5 million, authorized.

149 miles, 36-inch, main loops, 34 miles, 20, 24-inch gathering, compressor stations at Neuces County, Texas and St. Helena Parish, La., additional hp in eight stations, $51 million, before FPC.

Trans-Utah Pipeline, 120 miles, 16-inch, gas main line from Uinta Basin to Salt Lake City, considered.

Transwestern Pipeline Company, Houston, 1,305 miles, 24- and 30-inch, gas, main line, from West Texas and Oklahoma-Texas Panhandle area to Topock, Ariz., $193 million, before FPC.

Trunkline Gas Company, Houston, 204 miles, 26-inch, gas, main line from Tuscola, Ill., to Michigan-Indiana border; 464 miles, 30-inch loops between Longville, La., and Tuscola and 45 miles, 24-inch, in Texas, 183 miles gathering, Louisiana, 3000 additional hp at Longville station, $81.5 million, before FPC.

Underground Storage & Exploration, Upper Darby, Penn., 394 miles, 12-inch LPG, from Moundsville, W. Va. to Newark, N. J., $9 million, approved.

95 miles, 6-8 inch, laterals to Mauch Chunk, Penn., and to Philadelphia, planned.

United Gas Pipe Line Co., Shreveport, La., 203 miles, 30-inch, gas, between New Orleans and Mobile, Ala., $33.7 million, contracts let on 30-miles to O. R. Burden.

Valley Gas Transmission, Inc., Houston, 160 miles, 3 to 8-inch, gas, gathering, in Hidalgo, Brooks, Starr and Jim Wells Counties, Texas, $15 million, before FPC.

International

ACT Oils, Ltd., Montreal, 400 miles, crude, Dawson Creek, B. C., to Bella Coola, B. C., before B. C. government.

Alaska-Yukon Refiners and Distributors, Ltd., Edmonton, Alta., 150 miles, products, serving Alaska and Yukon territory, $3.5 million, planned.

Alberta Natural Gas Company (Jointly owned by Westcoast Transmission Co. and Alberta & Southern Gas Co. Ltd.) 36-inch, gas, Alberta border to British Columbia-Idaho border, supply gas to Pacific Gas & Electric Co., $40 million, planned.

Bituminous Oil Pipeline Co., Calgary, 250 miles, crude, from Athabasca tar sand plant in northeastern Alberta to Edmonton, approved.

British Petroleum Co., 60 miles, crude, from deep water tanker terminal at Milford Haven, U. K. to Llandarcy Refinery, **$18 million, planned.**

Burmah Oil Co., Ltd., 850 miles, crude, 20 inch, from Nahorkatiya to Calcutta, **India, planned.**

Colombian Petroleum Company, 68 miles, 12-inch, crude, Cicuco field to Covenas, planned.

Consolidated Gathering Systems, Ltd., Calgary, 198 miles, crude, Sturgeon field to Edmonton, planned.

Development and Resources Corp., 70 miles, 8 inch, gas, from Agha Jari oil field to Ahwaz, Iran, planned.

Elburz Oil Corp., 1000 miles, crude, from Central Iran to Alexandretta, Turkey, $450 million, planned.

Entre Nazionali Idrocarburi, Rome, Italy, crude, from Qum field in Iran to the Mediterranean Sea, considered.

Foothills Pipe Line, Ltd., 500 miles, 12 to 16-inch, LPG, from Alberta to Pacific Coast, $80 million, considered.

Hydrocarbons Pipeline, Ltd., Winnipeg, Manitoba, 880 miles, 6-8 inch, products, from Edmonton to Winnipeg, $35 million, partial authorization.

Independent Pipe Line Co., 2,019 miles, 34-36-inch, crude, Edmonton to Montreal, 23,000 pump horsepower, $395 million, before Borden Commission.

Interprovincial Pipe Line Company, 350-mile extension from Toronto to Montreal, looping line from Edmonton to Toronto, crude, $240 million, considered.

Mid-Continent Pipe Lines, Ltd., 1500-mile, 30-inch crude, Edmonton to Chicago, planned.

NATO, 211 miles, crude, 6-inch, between Malatya-Cetinkaya-Erzincan, Turkey, $6 million, bids asked.

National Iranian Oil Co., 146 miles, 6 inch, crude, from Azna to Isfahan, Iran, $5 million, planned.

1000 miles, 38 inch, crude, from central Iran to the Turkish Mediterranean coast, considered.

Peace River Oil Pipe Line Co., Ltd., 70-mile, crude, Swan Hills to Iosegun Junction, approved.

Petroleos Mexicanos, 600 miles, 24-inch, gas, from Pemex City to Mexico City, $50 million, construction underway.

38 miles, 4 inch, products, from Mexico City to Toluca, $500,000 planned.

126 miles, 4, 6 and 8 inch, products, from Mexico City to Cuernavaca and Puebla, $2.5 million, planned.

Sui Gas Transmission Co., Multan, Punjab, India, 145 miles, 8-inch, gas, from Sylhet to Dacca, East Pakistan, $9 million, considered.

130 miles, 16-inch, gas, main line, Multan to Lyallpur, planned.

Trans-Europe Pipe Line, 700 miles, 30 inch, main trunk, crude, from Mediterranean to northern Europe, considered.

Union Gas Company of Canada Limited, 45 miles, 8-inch, gas, main, Stratford to Goderich, Ontario; 10-miles, 8-inch, main, to Amhertburg; 10-miles, 12-inch, lateral, Galt to Brantford, planned.

Westcoast Transmission Company, Ltd., 174 miles, 30-inch, gas, Savanna Creek gas field, Alberta, to British Columbian border, $45 million, planned.

650 miles, crude, from Peace River area to Vancouver, $100 million, planned.

Williams-McWilliams Industries, Inc., New York, 441 miles, 6-inch, crude, Villa Montes, Bolivia to Villa Hayes, Paraguay, considered.

Yacimientos Petroliferos Fiscales, Buenos Aires, Argentina, 621 miles, 12-inch, products, Mendoza to San Lorenzo, Argentina, $19 million, planned.

281 miles, 12¾ inch, crude, Pichanal to San Miguel Tucuman to Techint, S. A., planned.

450 miles, 16-inch, crude, from Neuquen Province to Bahia Blanca, planned.

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ALLEN MOBILE CRANE

Built to the same high standard as its smaller contemporary —the well-known model K—this new mobile crane excavator will give the same long, trouble-free service, with a much bigger performance.

Designed and built at Cowley, the six-wheeled chassis is powered by a Gardner 5 L.W. oil engine, giving 94 b.h.p. at 1,700 r.p.m.

There is a separate power unit (Gardner 4 L.W.) for turntable

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Engineering Design —56—Maximum Allowable Working Pressure.

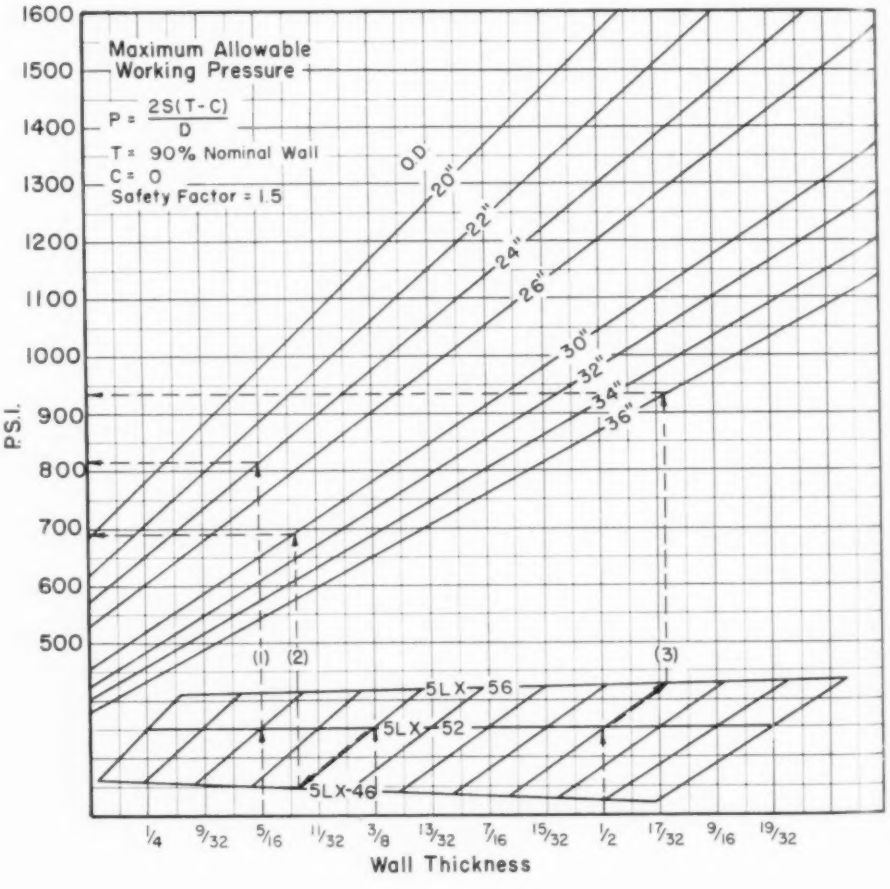
This chart provides a convenient way to determine the maximum allowable working pressure for API line pipe 5LX-46, 5LX-52 and 5LX-56. The chart is based on the formula:

$$P = \frac{2S\,(T\text{-}C)}{D}$$

T = 90 percent nominal wall
C = 0
Safety factor = 1.5

If the wall thickness is known, draw a line to the horizontal line for 5LX-52 pipe. Follow the diagonal line at this point to either the 5LX-56 or 5LX 46 horizontal line, then vertically until the diameter line is intersected. A horizontal line at this point indicates the maximum allowable working pressure. Examples: 1. A 24-inch O.D. line with 5/16-inch wall of 5LX-52 spec. will have a maximum allowable working pressure of 815 psi. 2. A 30-inch O.D. line with ⅜-inch wall of 5LX-46 spec. will have a maximum allowable working pressure of 690 psi. 3. A 36-inch O.D. line with ½-inch wall of 5LX-56 spec. will have a maximum allowable working pressure of 935 psi.

Submitted by: W. N. White
Edmonton, Alta., Canada



Engineering Design —55—Corrected Head Loss Charts for Various Sizes of Pipe

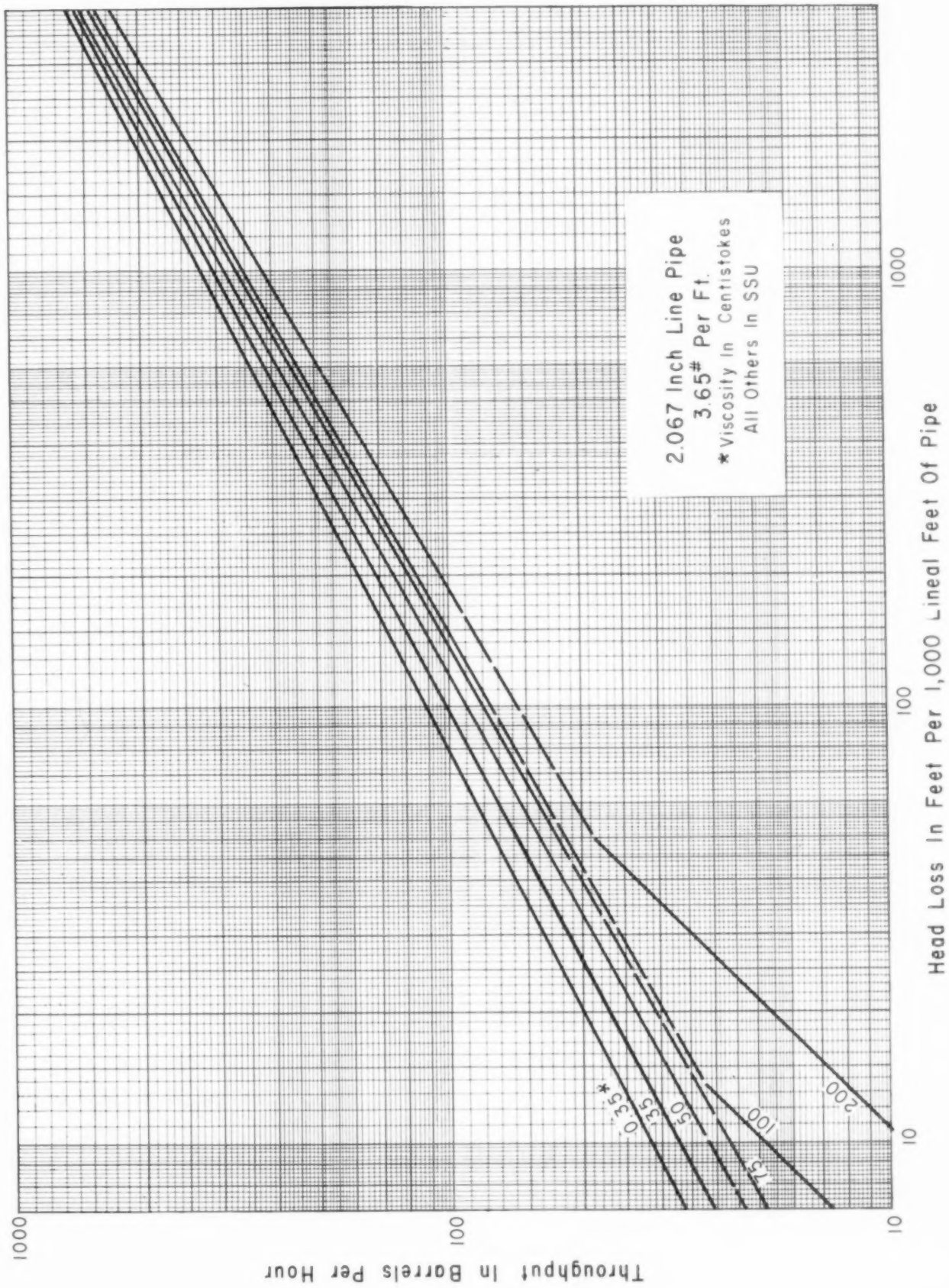
(The grid lines were reversed in Engineering Design 55, Chart 15 in a series of nineteen 2-inch pipe, published in October. This is the corrected chart which should be substituted for the chart published in October.)

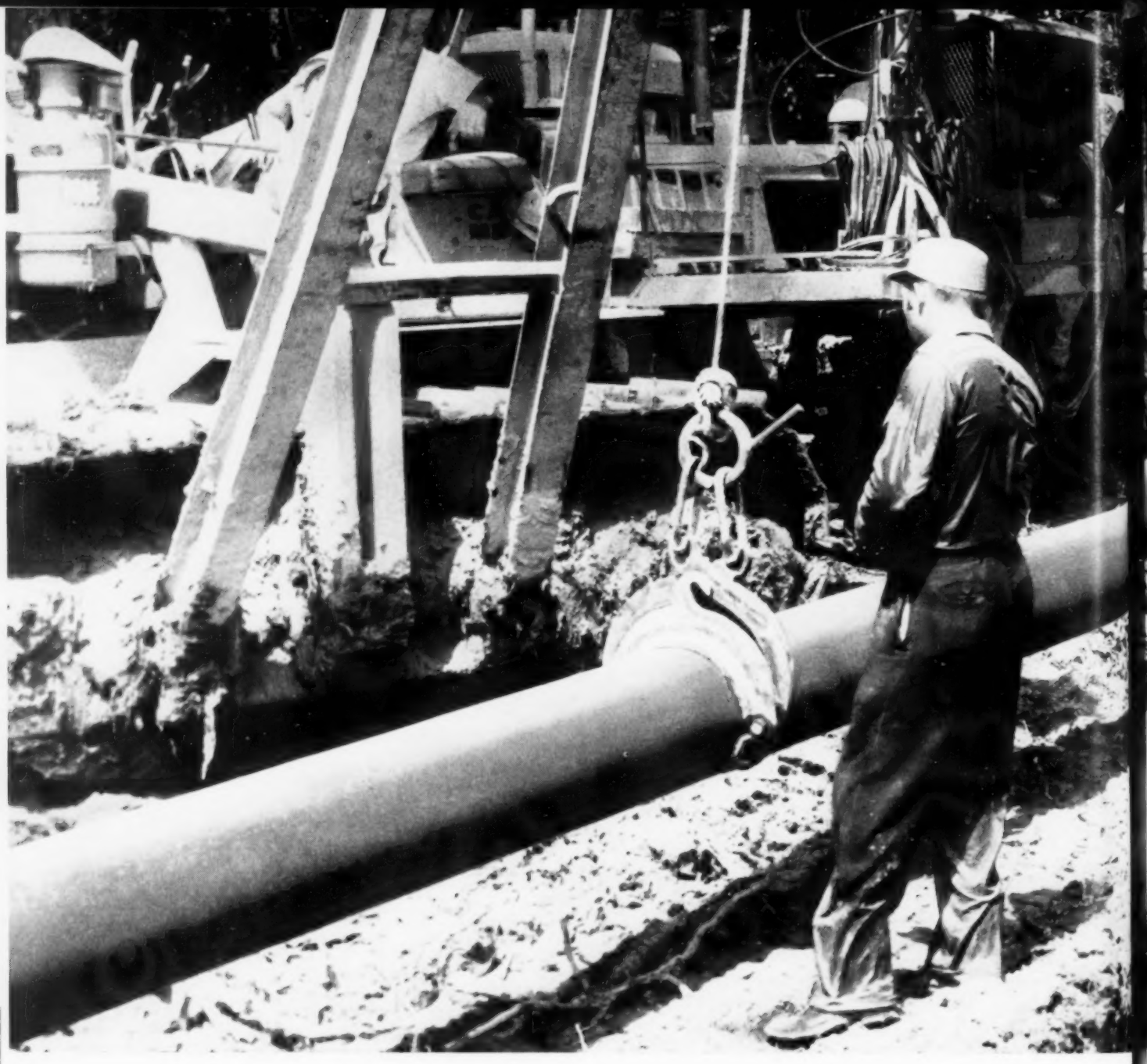
Friction Loss Characteristics for 2-inch pipe were computed by a pipe line company using data of the Hydraulic Institute. Use of these data in laminar and critical zones is adequate for estimates. Friction losses in transition and complete turbulent zones are very accurate.

Corrected Version of Chart 15

(Chart 15 in a series of 19—2-inch line pipe)

ENGINEERING DESIGN 55





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now produced to 42 in.

It's Bethlehem Steel Line Pipe for many reasons for top quality in materials and manufacture; for to uniformity in size, surface, and wall; for top performanc in every type of installation. At our Steelton, Pa., plant w have new facilities for cold-expanding electric fusion-wel pipe *to 42 in. OD.* And on our new mill at Sparrows Point Md., we produce electric resistance-weld pipe from $5\frac{9}{16}$ i to 16 in. OD *in lengths to 60 ft.*

For top economy in every phase of pipe line constructio and operation, use Bethlehem Steel Line Pipe. Let ou nearest sales office quote on your requirements.

	SIZES (in., OD)	WALL THICKNESSES (in.)	LENGTHS	SPECIFICATIONS
HYDRAULICALLY EXPANDED ELECTRIC FUSION-WELD (submerged arc)	22 and 24 26 through 36 36 through 42	¼ to .438 incl. ¼ to ⅝ incl. ¼ to ¾ incl.	40-ft ①	API 5LX, Grades X42, X46, X52 & X56
ELECTRIC RESISTANCE-WELD	5 (nom) to 16	API	to 60-ft	API 5L, Grades A & B API 5LX, Grades X42 & X46
CONTINUOUS BUTT-WELD	½ to 4 (nom)	API	SRL 24 to 26-ft DRL to 50-ft	API 5L
COMPRESSOR STATION PIPE in diameters, thicknesses, and lengths as required.				

① Expanded after two 20-ft lengths are joined with girth weld.

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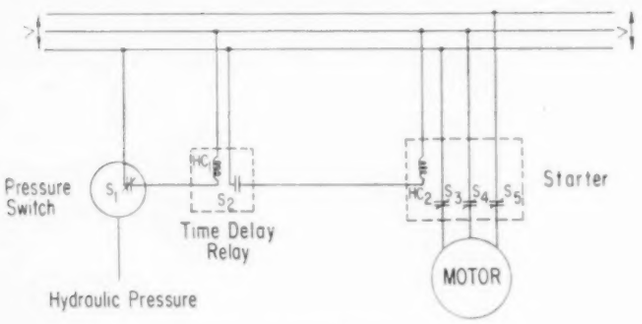
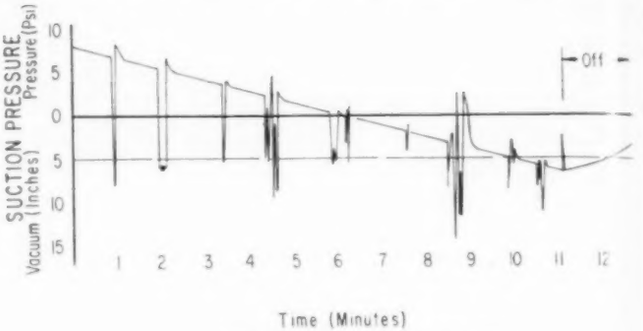
How to do it

PIPE LINE HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, PIPE LINE INDUSTRY, P. O. Box 2608, Houston 1, Texas



PORTION OF CONTROL CIRCUIT
FIGURE 1



PUMP SUCTION CHARACTERISTIC
FIGURE 2

Pressure Dampener for Control Circuits Reduces Pulsation

One of the big problems in the pipe line transportation industry is the pulsation or surge caused by reciprocating equipment or any one of many causes of ununiform flow in pumping operations. One pipe line firm has solved this problem as far as dampening these pipe line pressures for use in simple and economical control systems for its pumping equipment.

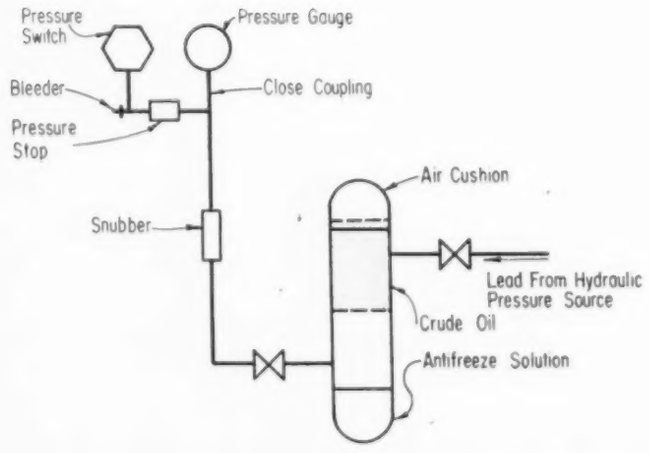
Figure 2 illustrates the suction line characteristic during final minutes of the equipment's operation cycle. It has been determined that equipment operation should be halted at such time as a steady suction vacuum of 5 inches can be held for a period of 60 seconds. At that time the equipment should stop operating.

The pressure switch has been set for the normally closed contracts to break at vacuum below 5 inches. In Figure 2 there are a number of times in which the vacuum drops below 5 inches. In each of these instances S_1 in Figure 1 in the pressure switch breaks, de-energizing the holding coil in the time delay relay and starting the timing device in TDR_1. However, each time the vacuum decreases to less than 5 inches within the 60 seconds run of TDR_1, the S_1 makes it contacts re-energizing the TDR_1 canceling the amount of the 60 second delay lapsed. It is not until 10 minutes have passed in Figure 2 that vacuum remains greater than 5 inches for more than 60 seconds. When this occurs, contacts S_2, in the time delay relay, are made which energizes the holding coil in the starter which in turn breaks the starter contacts and shuts the motor down. The motor will remain inoperative by means of a reset circuit which is deleted from Figure 1 for simplicity of explanation. The motor would be restarted by resetting the circuit or by means of other pressure controls overriding this circuit, each similarly tempered by the time delay dampener.

Any number of these circuits can be used together for controlling motor speeds, combinations of speed etc., all done by pressure. Pressure switches and time delay relays have proven reliable and long lasting.

Whereas the example is for suction pressure control, the application can be made for high pressure control, pressure differential control, flow control (differential pressure across orifice plates) and other applications.

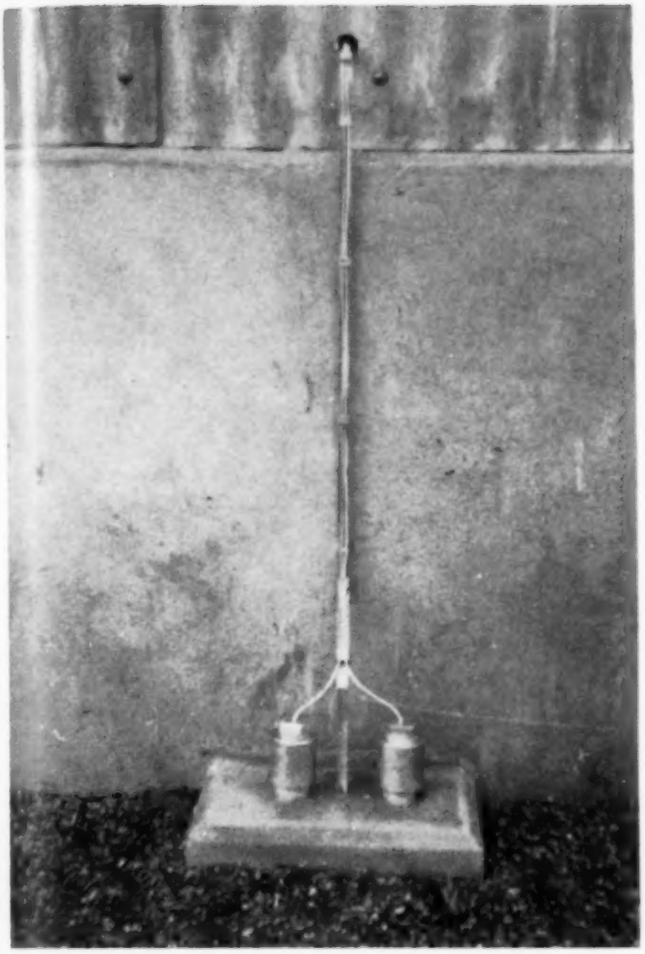
Simple Liquid Spacer Protects Control Equipment

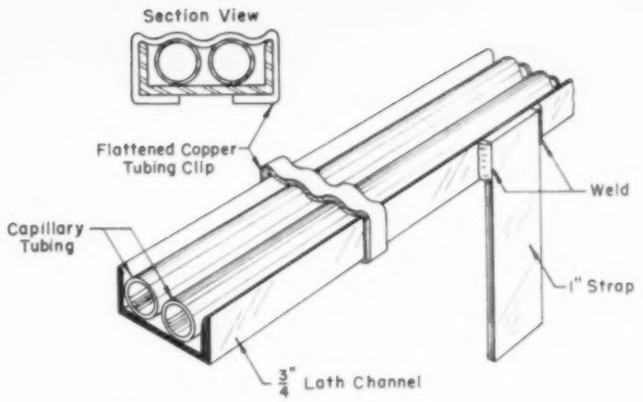


The use of a simple liquid spacer has proven instrumental in eliminating control failures due to paraffin and other foreign matter clogging delicate control devices, particularly pressure switches, pressure gages, etc., used in controlling oil field equipment on hydraulic pressure. The chamber is made of a 10-inch piece of 2-inch pipe with weld caps on each end and the two leads arranged as in sketch.

Antifreeze is a good spacer since it will not commingle with the crude, freeze nor become highly viscous with low temperatures.

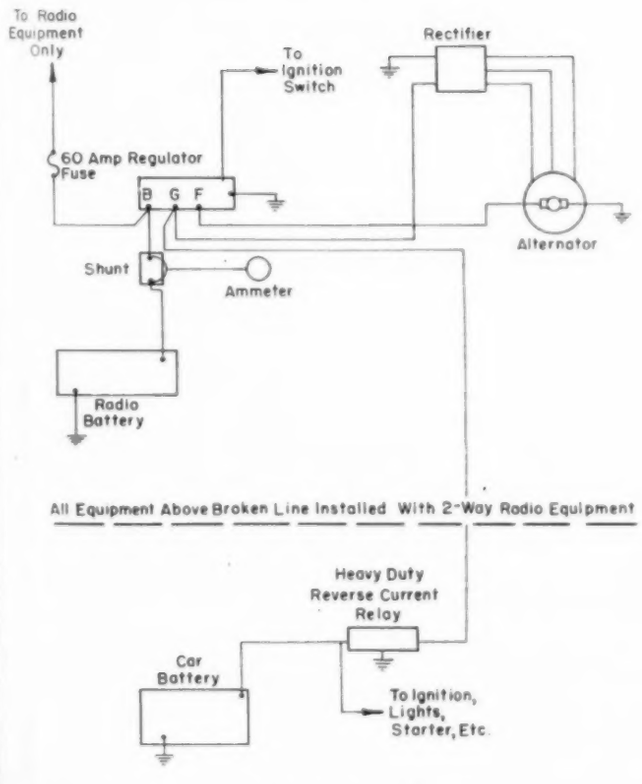
It can also provide the additional feature of the air cushion for snubbing or dampening pulsations. The volume of the air cushion can be controlled by the length of the container and can be eliminated if desired by putting a bleeder on top of the chamber.





Lath Channel Used For Routing Capillary Tubing

For routing of capillary tubing, which is not self-supporting, ¾-inch lath channel may be used which is neat and eliminates possible damage while in service. This channel has an internal web width which will accommodate two standard diameter tubing runs and is easily mitered or bent to facilitate changes in direction. For intermediate supporting of the channel, it can be bolted to flat surfaces or bracketed with 1-inch wide strap to other structures. To hold the tubing within the channel web, a short piece of copper tubing can be flattened and bent around the channel across the web opening.



Alternators Provide Auxiliary Current Source

Radio cars equipped with alternators can be hooked up as shown in the accompanying drawing to provide an auxiliary source of current for starting the vehicle after the radio battery is discharged. With the suggested circuit, the vehicle has two batteries, one for the radio and one for the car's regular circuit. One regulator is used which regulates the charging rate.

The reverse-current relay of the alternator's regulator automatically separates the two batteries when the ignition switch is off. Thus, if the radio draws heavily on its battery when the engine is not running, the vehicle can still be started from the other battery. After the vehicle is started, the alternator will recharge the radio battery.

Since the batteries are connected in parallel, and if care is taken not to set the alternator's voltage too high, the danger of overcharging is small. The water level of these batteries should be watched closely. Even if the life of the car battery is shortened, savings will be realized because of the fewer occasions that mechanics or tow cars are called out for dead batteries.

Grounding Instructions Help Prevent Accidents

Installing a sign with proper grounding instructions near a truck unloading rack can help prevent possible accidents. The sign should be placed near the grounding cable and switch and give all steps necessary for safe unloading of crude or LPG. In addition to giving proper grounding methods, the sign will serve as a reminder to anyone using the unloading facilities.

WISCONSIN-POWERED Machine

Bends Pipe to Fit Terrain

...at Pressures Up to *250 TONS!*

HANDLING pipe of any size from 6-in. to 20-in. dia., and up to ½-in. thick in the largest size, this Wisconsin-powered "CINCH WV Series" Vertical Pipe Bending Machine makes practically any desired bend . . . tailor-made to fit the terrain and the contour of the space for laying the pipe.

Even on the greatest angles of the bends, the pipe thickness is kept uniform and free from ripples or wrinkles, according to the manufacturer, M. J. Crose Mfg. Co., Inc., Tulsa, Okla. The actual bending operation is performed by four hydraulic cylinders which exert pressures up to 250 tons at the places where pipe is to be bent. The hydraulic pump which activates the cylinders, is powered by a MODEL VG4D (37 hp.) WISCONSIN HEAVY-DUTY AIR-COOLED ENGINE, equipped with electric starting and generator.

In addition to its value in oil field service, this machine is said to be an ideal piece of equipment for medium or small-sized contractors, as a permanent investment. It is not uncommon to see one of these small bending machines operating on busy thoroughfares in metropolitan areas, where until recently only fittings or welding methods were used.

Wherever there's a tough power job to be done, you'll find Wisconsin Engines (3 to 56 hp.) delivering High Torque, Load-Holding power service . . . operating at temperatures from low sub-zero to 140° F. *You* can't do better than to specify "WISCONSIN" for *your* equipment. Write for Engine Bulletin S-223.

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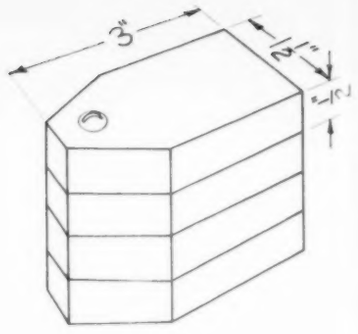
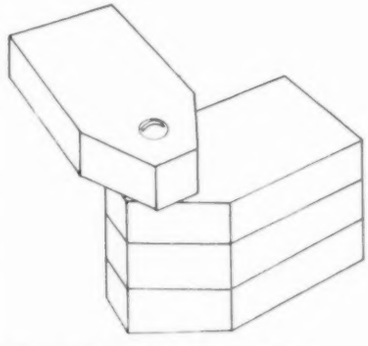
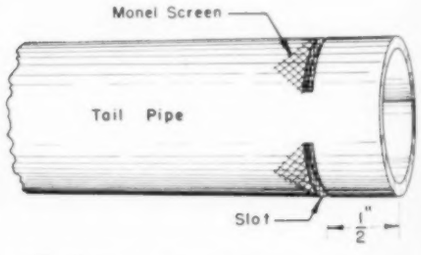




Step Blocks For Drill Press Made From Plate

Drill press work frequently needs a small amount of blocking for ease in drilling.

An easy way to provide this blocking is to cut several pieces, as shown, out of one-half inch steel plate. The pieces are then loosely bolted together for ease in handling.



Fabricate Spark Arrester From Mesh Metal Screen

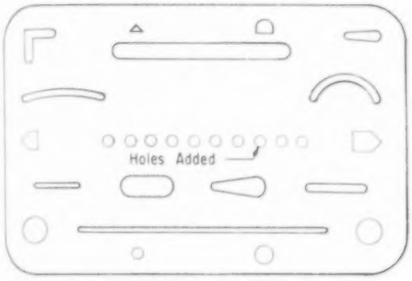
Some states require that spark arresters be installed on motor vehicles. The United States Forest Service is doing considerable research on spark arresters and may eventually publish a list of approved arresters. Until a definition of an adequate spark arrester is adopted in your state, a temporary spark arrester can be fabricated as follows:

Saw a deep slot about ½-inch from the end of the vehicle's tailpipe and insert a square piece of 16 by 16-mesh monel metal screen. Fold the corners of the screen back along the

tailpipe, and the job is done.

This type spark arrester suffers the disadvantage of increasing back pressure and will choke up some. These same disadvantages are true of the rolled-screen type spark arrester; however, the suggested type has the advantage of easier and more economical installation, easier replacement, longer lasting screen and having less chance of being knocked off. It is actually self-cleaning to an extent, through the opening in the bottom.

Since tailpipes tend to rust off at the end, an extension can be used to carry the screen when this happens.



Modify Erasing Shield To Make Dotted Lines

Sometimes it becomes necessary to change a solid line to a dotted line when drafting. By placing a series of holes in an erasing shield as demonstrated, it is possible to make the conversion simply by erasing through the holes.

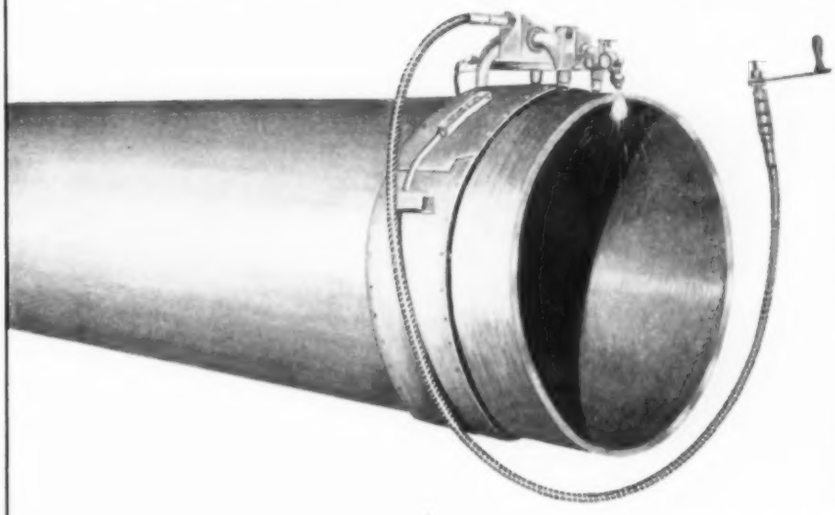
Chain Operated Valve For Emergency Fuel Cutoff

When it is necessary to have a valve which will cut off the main fuel line in case of an emergency, a plug valve may be placed just outside the station door as shown. The valve handle is made from a piece of scrap metal which has been cut out by the welder to fit the end of the plug. The ends of the lever are drilled and a short length of chain fastened to each end. The square in the middle is made at an angle so that the lever is normally in a 45 degree position when open or closed.

In case it is desired to cut off the entire fuel supply, it is only necessary for the operator to come out the door or down either side of the building and feel for the chain nearest the corner. One yank does the trick. As soon as it is desired to return the line to service, it is only necessary to pull the other end of the chain and the valve is opened again.

BEVELS 6" PIPE

BEVELS 48" PIPE



C-R-C IMCO BEVELERS fit all pipe sizes 6" to 48" O. D., cut perfect bevels, and out-of-round pipe, too. Single lightweight unit does work of several, costs you less to buy and use.

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For additional information see page 108, Pipeline Composite Catalog.

The CRC IMCO Pipe Beveling Kit contains a complete range of bands for beveling a variety of pipe sizes. With this convenient selection of sizes, the operator need only make one trip to handle all pipe beveling requirements including back beveling. The sturdy steel case and number of bands are optional.

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What's Happening

among MEN in the INDUSTRY

W. A. Robinson

J. N. Fuquay

Sun Pipe Line Company announces the promotion of three engineers in the Beaumont Crude Lines department. **James Neill Fuquay** has been named chief engineer; **Edgar Miller Jr.** and **Wallace Robinson** have been appointed to the newly created position of senior engineer in the Beaumont office.

Fuquay started with Sun in 1948 as a civil engineer. He was appointed assistant superintendent of the Crude Lines department in 1954 and later was superintendent for the Southwest Texas area. Miller has been with Sun since 1948 and served in South Texas as connection foreman and assistant gager. In 1953 he was assigned to Philadelphia general office as instructor in the company's "Economy at Work" program and in 1955 he returned to Beaumont as assistant chief engineer. Robinson joined Sun in 1949. He worked on the construction of **Mid-Valley Pipeline Company** and in 1950 was stationed at Beaumont. He was named mechanical engineer in 1956.

Edgar Miller, Jr.

The Houston Corporation announces executive officers for the parent company and its subsidiaries. **G. B. Bennett** has been elected vice president of sales and operations for the parent company, and **Dwight B. Sprow** has been elected executive vice president of Houston subsidiaries, **Houston Texas Gas and Oil Corporation** and **Coastal Transmission Corporation.**

Other appointments include **Don A. Hardesty,** superintendent of pipe lines and **J. B. Zachary** as superintendent of compressor stations for the subsidiaries.

Bennett had been with Sun Oil Company for 20 years and Sprow previously was vice president and operating superintendent of Natural Gas Pipeline Company of America.

Hood Construction Corporation announces the appointment of **Ed. W. Barnes** as head of the Industrial division, formed to engage in installation of plant facilities where mechanical equipment and power or process piping predominate together with all appurtenant construction.

The new division is located in present Hood headquarters in Whittier, Calif.

Continental Pipe Line Company announces the appointments of six personnel to new positions. **D. S. Skinner,** superintendent of the company's North Texas district, becomes superintendent of **Cherokee Pipe Line Company's** Products division. **L. C. Secrest,** assistant superintendent Oklahoma-Kansas-Illinois district, was promoted to superintendent of North Texas district. **R. W. Lee,** staff engineer, will replace Secrest. **R. E. Lombard,** superintendent, **Yellowstone Pipe Line Company,** affiliate of Conoco, was transferred to the Griffith, Ind., terminal as construction superintendent. **E. P. Kienow** has been promoted from assistant superintendent to superintendent of Yellowstone Pipe Line Company. **W. P. Ilgen,** staff engineer becomes assistant superintendent of Yellowstone.

Randall T. Klemme, director of marketing, economic research and area development for **Northern Natural Gas Company,** was one of five American economists invited by the Belgian government to address the "International Congress for Regional Economy" at Ostend and Brussels, Belgium September 7-12.

Klemme's topic for discussion was "Private Enterprise in Regional Economic Development in the United States," particularly highlighting the Northern Plains. Klemme joined Northern Natural in 1958. Previously he had been a director of the Oklahoma Department of Commerce and Industry. He also served as vice president of Oklahoma A&M College and as the first administrator of the U.S. Point Four Program in Pakistan.

Frank G. Gass, formerly an engineering writer in the **Southwestern Industrial Electronics Company,** Publications department, has been appointed sales engineer.

Frank G. Gass

Gass has been associated with the automation products of the Control division since 1957. Prior to joining SIE, he had 17 years experience in airline transport operations with domestic and international carriers. Gass served as a superintendent, wrote manuals and instructed in flight operations, dispatching, communications and electronics.

Clyde McGraw, president of **Transcontinental Gas Pipe Line Corporation,** has been elected to a two-year term as a director of the American Gas Association.

J. Theodore Wolfe, president of **Baltimore Gas and Electric Company,** was elected president, and **Orville S. Carpenter,** president of **Texas Eastern Transmission Corporation,** was reelected to the board. Other officers include **Wister H. Ligon,** president and director of **Nashville Gas Company,** first vice president; **Lester T. Potter,** president of **Lone Star Gas Company,** second vice president; and **Vincent T. Miles,** treasurer, **Long Island Lighting Company,** treasurer.

George C. Roth, director and vice president of operations, **Cities Service Gas Company,** has retired.

George C. Roth

Roth served 45 years with Cities Service having joined the company in 1913. He has worked as expense ledger auditor, clerk in Sales, Pipe Line and Gas Transmission departments, assistant to superintendent of operations, and assistant to operations manager until 1953. He was named vice president in 1953 and was made a director and vice president of the Cities Service Gas Producing Company.

Northern Natural Gas Company announces the promotion of **Frank D. Stockman** and **Vincent E. Martinson** to managerial positions in the Gas Supply department.

Stockman has been named manager of Reserves and Availability division, and Martinson becomes manager of Underground Storage division. Stockman has been with Northern since 1956. Previously he was associated with Phillips Petroleum Company, Martinson has been with the company since 1949. He will be responsible for the operations and further development of Northern's Redfield, Iowa, storage field and exploration and development of additional underground facilities.

Maung Tin Win of Kyaukme, Northern Shan State, Burma, began a four month "on the job training" assignment with **Sinclair Pipe Line Company.**

Maung Tin Win

Win is one of several Burmese students now in U.S. chosen for advanced study and special training by the Burmese government. Win will work closely with Sinclair technicians in the field to gain first hand knowledge and experience in microwave and other communications techniques. He will study all phases of Sinclair's wholly and partially owned communications network vital to the operation of the common carrier's crude and products pipe line system.

Jack D. Head has been named vice president and general counsel of **Texas Eastern Transmission Corporation.** Head succeeds **Charles I. Francis** who retired.

Jack D. Head

He will supervise all legal activities of the company. Head had been serving as assistant general counsel of Texas Eastern since 1956. Previously he was active in company legal affairs including Federal Power Commission proceedings, gas purchase contracts and other regulatory matters.

Philip M. Cordell has been appointed manager of the newly-created Crude Oil Supply department of **Texas Gas Corporation.** Cordell became coordinator and economist for Texas Gas Corporation in 1956 after serving in that capacity with the Ford Motor Company Tractor and Implement division. Previously he had been with Gulf Oil Corporation and Continental Oil Company.

Roy Simmons, Washington, D. C., attorney, has been named chairman of the legal committee for the **Transportation Club of the Petroleum Industry.**

Simmons, who is associated with Dow, Lohnes & Albertson of Washington, succeeds **G. L. Phelps,** who died recently. Simmons also is attorney for the National Petroleum Association and has been active in oil trade matters for a number of years.

Glenn W. Clark, president of **Mississippi River Fuel Corporation,** was elected president of Independent Natural Gas Association of America.

Glenn W. Clark

Clark, who had been first vice president, succeeds **J. J. Hedrick,** president of **Peoples Gas Light and Coke Company.** Clark has been associated with the oil and gas pipe lines industry since 1930 when he became a member of Legal division of Empire Companies of The Cities Service System. He was named general attorney for Panhandle Eastern Pipe Line Company in 1938. He was selected vice president-general counsel and a director of Cities Service Gas Company in 1944. He became president of Mississippi River Fuel in 1956.

George E. Mays has been assigned to Hamburg, Germany, as assistant to **L. W. Finlay,** shareholders representative for **Standard Oil Company, N. J.**

Mays has been with Standard since 1938. He spent a number of years with **Interstate Oil Pipe Line Company** and in 1955 was made chief engineer and transferred to Transportation department of the parent company.

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For more data on advertised products, use Readers' Service Cards, last page.

R. Dean Grimm has been promoted to manager of the Gas Supply department of **Northern Natural Gas Company.** He will supervise the managerial functions of gas purchases, purchase gas operations, gas reserves and availability and underground storage. Grimm formerly was manager of Gas Reserves and Availability and Underground Storage.

R. D. Grimm

Grimm has been with Northern Natural since 1955.

W. L. Williams has been appointed treasurer and assistant secretary, and **B. Z. Kastler, Jr.,** has been named secretary and assistant treasurer for **Mountain Fuel Supply Company.**

The new appointments followed the retirement of **L. Clyde Olpin,** former treasurer and secretary. Williams had been assistant treasurer and assistant secretary. Kastler was company attorney and he will continue to direct the company's legal affairs. Williams joined Mountain Fuel in 1929 and was named assistant treasurer in 1951. Kastler has been with the company since 1952.

Guy T. Henry and **Paul R. Haas** have been named directors of the **Algonquin Gas Transmission Company.** Henry is president of Providence Gas Company, and Haas is administrative vice president of Texas Eastern Tranmission Corporation.

Before joining Providence, Henry served as president of East Tennessee Natural Gas Company. Haas previously was a vice president, treasurer and director of La Gloria Oil and Gas Company.

D. T. Lutz

Keith Bentz

Keith Bentz has been elected assistant vice president of operations of **Texas Illinois Natural Gas Pipeline Company,** and **D. T. Lutz** has been appointed to direct the activities of Employe Relations and Public Relations divisions for **Texas Illinois Natural Gas Pipeline Company.**

Bentz had been superintendent of pipe lines for Texas Illinois, and Lutz previously was superintendent of compressor stations for Texas Illinois. Bentz succeeds **D. B. Sprow,** and Lutz replaces **D. A. Hardestry.** Sprow and Hardestry resigned to join another corporation.

Bruce Jones has been appointed manager of supply and distribution for **La Gloria Oil and Gas Company.**

Bruce Jones

Jones served as products coordinator for La Gloria for the past year. Before joining La Gloria, he was assistant to the president of McMurrey Refining Company, a firm acquired by La Gloria in 1957. Previously he had been with The Texas Company, the Girdler Corporation and Panhandle Oil Corporation.

Rio Engineering Company announces two additions to its engineering and sales staff. **Frank I. Dorr, Jr.,** joins the corrosion engineering staff, and **Ben Russell** has been appointed to the sales staff. Dorr has 10 years experience in the corrosion engineering field, and Russell has six years sales experience in the corrosion field.

New York State Natural Gas Company has named **Charles A. Naylor** as training director to head the company's training section, Employe Relations department.

Prior to this association with New York Natural Naylor had been assistant to manager of personnel development at Koppers Company.

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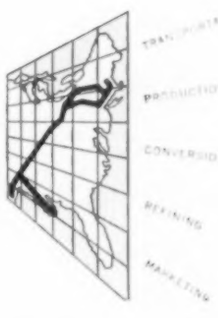

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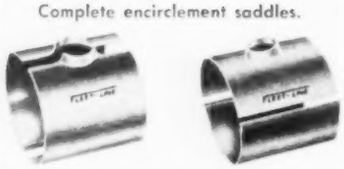

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WHO'S MEETING WHERE

November

Society of Automotive Engineers, national fuels and lubricants meeting, Mayo Hotel, Tulsa, Nov. 5-6.

Louisiana Polytechnic Institute, School of Engineering, Seventh Annual Instrumentation Conference, Ruston, La., Nov. 6-7.

Transportation Club, Petroleum Industry, annual meeting, Bismarck Hotel, Chicago, Nov. 10.

API 38th Annual Meeting, Conrad Hilton Hotel, Palmer House and Congress Hotel, Chicago, Nov. 10-13.

NACE, Western Region, fall meeting, Statler Hotel, Los Angeles, Nov. 17-19.

Mid-West Gas Association Gas Meter & Service School and Conference, Iowa State College, Ames, Iowa, Nov. 19-21.

ASCE, Structural division and Kansas City section, Conference on Electronic Computation, Kansas City, Nov. 20-21.

Natural Gasoline Association of America, Panhandle Plains regional meeting, Herring Hotel, Amarillo, Texas, Nov. 21.

"Legal Problems in the Tidelands," study program, Tulane University, New Orleans, Nov. 21-22.

ASME, annual meeting, Statler and Sheraton-McAlpine Hotels, New York, Nov. 30-Dec. 5.

December

NACE, biennial short course on cathodic protection, University of Illinois, Dec. 9-13.

Rocky Mountain Gas Association Annual Meeting, Denver, Colo., Dec. 30.

January

NACE, Canadian Eastern Regional meeting, Montreal, Quebec, Jan. 12-14.

Pipe Line Contractors Association, annual convention, Americana Hotel, Bal Harbour, Fla., Jan. 12-15.

NACE, Houston Section, annual short course in fundamentals of corrosion control, University of Houston, January 22-23.

Texas Society of Professional Engineers, annual convention, Shamrock Hilton Hotel, Houston, January 22-24.

February

NACE, Canadian Western Regional meeting, Calgary, Alberta, Feb. 12-13.

ASTM, Southwest District, annual meeting, Engineering & Scientific Society, Houston, February 26.

March

ASME, gas turbine power conference & exhibit, Netherlands-Hilton Hotel, St. Louis, March 1-5.

NACE, 15th annual conference, Sherman Hotel, Chicago, March 16-20.

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BOOKS

The Design and Construction of Liquefied-Petroleum-Gas Installations at Marine and Pipeline Terminals, Natural-Gasoline Plants, Refineries and Tank Farms, American Petroleum Institute, 50 West 50th Street, New York 20, N. Y., $1.

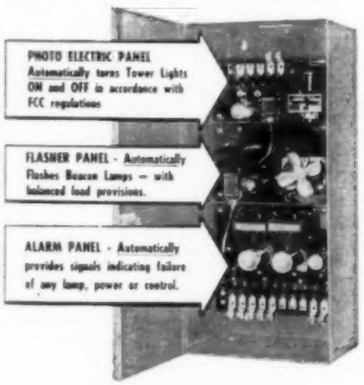
Known as the API Standard 2510, this manual is the result of several years of work by the API Committee on Liquefied Petroleum Gas and was designed to fill a specific gap in LPG standards. The manual is especially concerned with marine and pipe line terminals, natural gasoline plants, refineries and tank farms where they relate to the storage and handling of liquefied petroleum gases. The API booklet also contemplates and attempts to evaluate the specialized training and experience of the operating personnel in the type of installation covered.

Underground Corrosion, Melvin Romanoff, Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., $3.

This circular supersedes NBS Circular 450 issued in 1945 and is a final report on the studies of underground corrosion conducted by the Bureau over a period of 45 years. Results from both field and laboratory investigations are presented here. Also included are many references to industrial investigations and field experiences related to the Bureau's underground corrosion investigations.

Foreign remittance must be in U. S. exchange and should include an additional one-fourth of the publication price to cover mailing costs.

How to CONTROL and ALARM the TOWER LIGHTS of UNATTENDED Microwave and Communication Stations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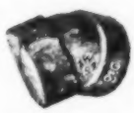
ROUGH FORGING BEFORE TRIMMING


ROUGH FORGING AFTER TRIMMING

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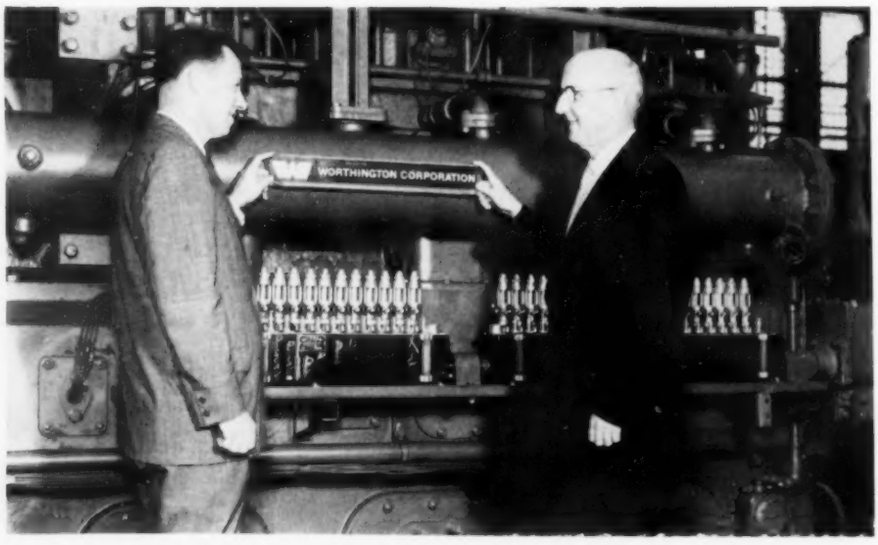
What's Happening among SERVICE and SUPPLY MEN



Worthington Corporation Adopts New Trademark

Worthington Corporation announces the development of a new trademark which will be used on all Worthington products. Company officials, V. M. Holmes, assistant manager of engine sales, and George Stevens, general manager of compressor and engine division, demonstrate the new brand on a compressor engine at Worthington's Buffalo, N. Y., plant.

Three Promotions Announced By Thew Shovel Company

The Thew Shovel Company announces three promotions in its Engineering department. R. J. Bushong has been appointed to the newly created position of director of product. He will have complete administrative authority and responsibility of the Product division. O. von Mehren has been named manager of the Product Engineering department and will have supervision and charge of all activities of the Engineering division.

R. H. Zeilman, director of engineering, will undertake specific assignments on engineering, research and development projects as part of the Product division's activities. He will act as consultant engineer.

Bushong, who joined Thew in 1957, previously has been chief engineer for Wayne Crane and American Hoist & Derrick. O von Mehren has been with Thew since 1945 and was appointed chief design engineer in 1954. Zeilman has been with the company for 38 years. He became chief engineer in 1938 and was named director of engineering in 1954.

Officers Chosen For Walker Constructors, Inc.

Walker Constructors, Inc., has been formed to carry out construction, maintenance and services for pipe line and petroleum industries. A subsidiary of Walker Associates, Inc., the company headquarters are located in Houston.

J. Leon Bates has been named vice president and general manager. Formerly he had been chief engineer at Texas Butadiene & Chemical Corporation. Jack C. Huff, previously construction manager of Grebe & Doremus Process Company, is the general superintendent of the new firm.

Howard Bean Joins Daniel Orifice Company

Howard Bean, former associate with National Bureau of Standards, has joined the Daniel Orifice Fitting Company as flow measurement consultant.

Bean served the Bureau of Standards for 40 years as a physicist, chief of Gas Measurement Instruments section, and chief of Capacity, Density and Fluid Meters section.

He developed the Bean Supercompressibility Apparatus, a device which helped in developing expansion factors that are still used in high pressure measurement.

Ohio Injector Names Walker District Manager

Owen H. Walker has been appointed Houston and Gulf Coast district sales manager for The Ohio Injector Company. Prior to his affiliation with Ohio Injector Company, Walker was associated with the Gulf Oil Company in sales and supervisory assignments.

Mechanics School Opened By Greer Technical Institute

Greer Technical Institute will conduct a school for training skilled mechanics for the earthmoving industry. The school will be inaugurated in Wilmington, Ill., and will be spread out over a period of 10 weeks. The course, titled Construction Equipment Mechanics, is aimed to provide practical and technical training to students to help meet the increasing needs of the construction industry. School will be held five and one-half days per week, 10 hours each day. It will include 60 hours instruction in each of the following departments: diesel engines, fuel injection systems, torque converters, final drives, steering system, tractor tracks, cable controls, welding and bulldozer rebuilding.

J. T. Calnon Named President Of Cummins Sales and Service

J. T. Calnon has been named president of Cummins Sales and Service, Inc. Ken W. Davis, former president, has been elected chairman of the board, and L. J. Troutz becomes vice president and general manager.

Calnon, formerly vice president-sales, has been with the company since 1945 and became vice president in 1952. Troutz is also vice president of Cummins Sales and Service de Venezuela, C. A.

F. H. Maloney Company Announces Two Appointments

Bob Churnside has been named manager of Chicago district, and Joseph V. Kidd becomes a new sales engineer for Houston area for F. H. Maloney Company.

The newly established Chicago office has been formed to serve the Great Lakes area and includes an area within a 500-mile radius of Chicago. Churnside had several years in Houston office in pipe line and industrial sales.

Kidd formerly was with Champlin Oil and Refining Company as assistant chief engineer.

General Electric Announces Three New Appointments

Three appointments in Engineering departments have been announced by General Electric Company. Charles W. Elston, formerly manager-turbine engineering for the Large Steam Turbine-Generator department, becomes manager-engineering for Gas Turbine department. Jack E. Downs, formerly manager-turbine advance engineering for LST-G department, is manager-turbine engineering in the same department. Harold D. Kelsey, former manager-engineering for GT department, is consultant-special engineering problems for that department.

Downs joined General Electric in 1942, became supervisor of steam design engineering of LST-G department in 1949 and in 1953 was made supervisor-turbine advance engineering. Elston has been with the company since 1937 and was placed on the Turbine Engineering department. He was made manager-turbine engineering, LST-G department, in 1949. Kelsey has been with General Electric since 1940 and worked in Turbine Engineering department. After holding numerous positions he was made manager-engineering GT department in 1953.

O. M. Lorenz

V. A. Hamilton

Jones & Laughlin Names District Sales Managers

Jones & Laughlin Supply division announces the appointment of two district sales managers.

V. A. Hamilton is district sales manager of the Texas Panhandle district, and O. M. Lorenz becomes sales manager of Illinois-Kentucky district.

Hamilton was previously a salesman at Pleasanton, Texas, and will have his headquarters in Amarillo. Lorenz, former assistant district sales manager of his territory, is headquartered at Olney, Ill. Hamilton joined the company in 1937. He was store manager at Bloomington, Texas, and salesman at Alice, Texas. He was appointed salesman at Pleasanton in 1947. Lorenz has been with Jones & Laughlin 19 years. In 1946 he was appointed salesman at Clay City, Ill., and in 1952 he became assistant district sales manager.

Link-Belt Speeder Corp. Announces Two Promotions

Link-Belt Speeder Corporation announces the promotions of two sales personnel to sales managerial positions. N. V. Chehak has been named sales manager in charge of all domestic and Canadian sales for the firm's line of crawler and rubber-tired shovel-cranes and the related diesel pile hamner equipment. D. F. Van de Roovaart becomes assistant sales manager for all domestic and Canadian sales.

Chehak has been with the company since 1948. He was appointed assistant sales manager in 1955. Van de Roovaart joined Link-Belt in 1936 and was appointed assistant sales manager for Western United States and Canada in 1957.

Worthington Selects Carter Vice President

A. E. Carter has been elected vice president of manufacturing for the Worthington Corporation. Carter succeeds Leslie C. Ricketts, who will concentrate on his responsibilities as group vice president of five Worthington divisions.

Carter formerly was associated with Ford Motor Company as manager of Ford parts plant. Previously he had been assistant general manufacturing manager with Ford Tractor and Implement division.

Allis-Chalmers Appoints District, Region Managers

Allis-Chalmers Manufacturing Company announces the appointments of district and region managers. Y. S. Hogg is manager of Tampa, Fla., district and E. T. Cuddeback has been named manager, General Products division sales, Southeast region.

Cuddeback will be responsible for promotion, planning and coordination of sales through the district offices for the company's motors, pumps and motor controls, and Texrope drives. Cuddeback joined Allis-Chalmers in 1946, became manager of Tampa district in 1948 and has been manager of Florida district since 1952.

Hogg, who joined the firm in 1949, had been a sales representative working out of the company's New Orleans district office.

Lufkin Foundry and Machine Opens Office in Sterling, Colo.

Lufkin Foundry and Machine Company announces the opening of new offices in Sterling, Colo., with E. H. Nixon, Jr., as manager. The Sterling office will handle sales and services for the Julesburg Basin area.

Nixon has been engaged in oil field sales since 1952, and has had a year of factory training at Lufkin's home offices.

W-S Fittings Works Promotes David Wroten

David P. Wroten has been named district manager, Southeastern territory, for W-S Fittings Works, Forge and Fittings division, H. K. Porter Company, Inc.

Wroten, with headquarters in Atlanta, will assist and service W-S distributors in the states of Tennessee, North Carolina, Mississippi, Alabama, Georgia, South Carolina and Florida. He has been with the company since 1953 and served as an inside sales representative until 1957.

MIDDLE of *Nowhere?*

Even in isolated areas, you can have attractive and comfortable field housing that will attract and keep top quality employees.

Across the continent, major companies are finding that WHITMOR Homebuilders can put quality field homes on the job . . . anywhere . . . at a cost within any field housing budget.

WHITMOR takes the problem from the day you OK the contract until your employee turns the key. Site-planning designing, specifications, construction and all utilities. WHITMOR handles it all on one purchase order. Site-built (not prefab), by skilled field crews, WHITMOR homes are the result of 36 years of experience in home building.

Whether you need a few houses, or a complete small town with streets and all utilities . . . housing needn't be a headache any longer.

Please send me, without obligation, more information about WHITMOR Field Homes.

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UP TO
37 CHANNELS
IN THE
Voice Band
(300 to 3000 CPS)

with Comvor®
DATA TRANSMISSION TERMINAL

RFL Model 912
Operates over Wire Circuit or Microwave

•

Reliable HIGH-SPEED Continuous Control
of
PUMPS
VALVES
MOTORS
GENERATORS
RELAYS
ETC.

The Model 912 Comvor, an audio frequency shift terminal, is used in the transmission of telemeter, telegraph or control signals over either wire line, microwave, or carrier. Up to 90 individual information channels are available in the audio spectrum.

Reliable frequency shift method of keying is used. All essential controls such as transmitter output level and receiver input level are included.

Each terminal contains its own power supply which provides an additional 60 milliamperes at both the transmitter and receiver for the operation of relays, stepping switches, selector magnets, and other components used in telemetering, control and telegraph applications.

WE CAN HELP YOU
Our Applications Department is ready to assist you in your control, telemetering or communications problem. Phone DEerfield 4-3100.

Write for Technical and Application Data.

Radio Frequency
LABORATORIES, INC.
Boonton, New Jersey, U. S. A.

Frost Engineering Becomes Maloney Distributor

Frost Engineering Service Company has been appointed exclusive Southern California distributor for Maloney pipe line specialty products. Appraising Maloney's rubber sphere pipe cleaner are seated, left to right, Jim McBrien, Maloney vice president and general sales manager; Vern Frost, Frost Engineering; and Dick Maloney, Maloney Western division manager. Standing are John Merrill, Frost Engineering general manager; and Jack Crawley, Frost Engineering office engineer.

A. L. Bupp Promoted By Bucyrus-Erie Co.

Alexander L. Bupp, assistant treasurer of Bucyrus-Erie Co., has been named manager of planning. The new position includes corporate planning, market research, organization planning and office management. In his new position, Bupp will assist R. G. Allen, executive vice president of the company.

Bupp has been with the firm since 1939. He served as sales engineer and was assistant manager of the Export Sales department prior to his appointment as assistant treasurer in 1956.

Fred C. Catron Joins Master Tank and Welding

Fred C. Catron has joined Master Tank and Welding Company as sales engineer. For the past eight years, Catron has been in all phases of steel fabrication for the chemical and petroleum industry.

At Master Tank and Welding he will be working with pressure vessels and large diameter transmission pipe.

Crosby Valve & Gage Elects Erling Klafstad President

Erling Klafstad has been elected president of Crosby Valve & Gage Co. and its affiliate The Ashton Valve Co. Klafstad formerly was associated with Manning, Maxwell & Moore, Inc. as assistant director of engineering, Consolidated Ashcraft, Hancock division.

Previously he worked with Crosby as development engineer, chief engineer and executive vice president.

Pendleton Tool Industries, Inc. Elects Bandoli Vice President

Marvin S. Bandoli has been elected vice president of Pendleton Tool Industries, Inc. He has been with the company since 1952 when he was named vice president, marketing. Prior to joining Pendleton, Bandoli was vice president for sales of Clary Multiplier Corporation; vice president for sales of Tracy Manufacturing of Victor Adding Machine Company and head of his own distributing firm.

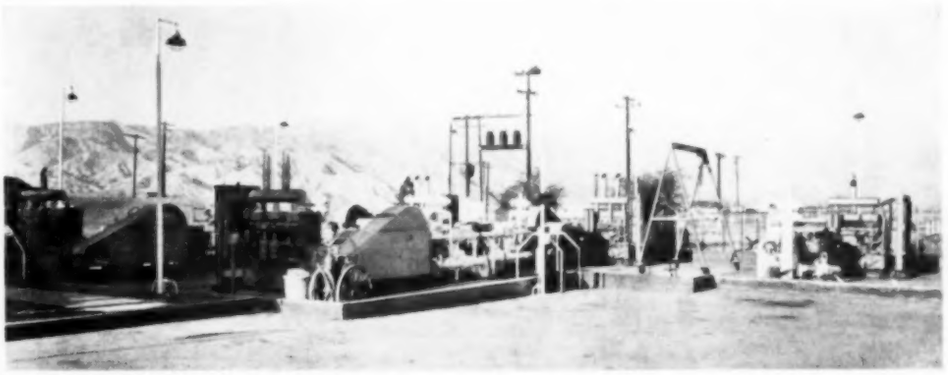
Specify
PELCO
Welding Saddles

PELICAN SUPPLY CO. INC.
P. O. Drawer 1108 Shreveport (84), La.
SEE YOUR NEAREST SUPPLY HOUSE

All they want these engines to do is *RUN...and RUN...and RUN*

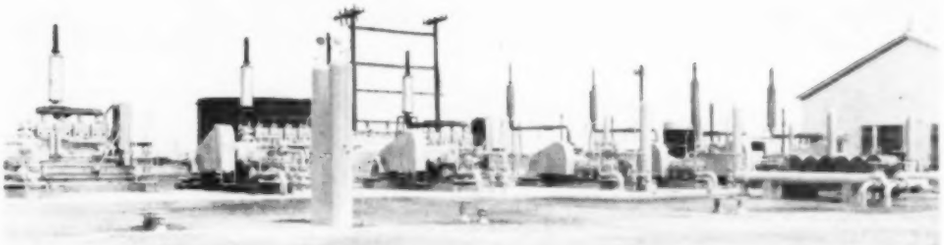
And they do! Twenty-four hours a day. Continuous up-to-capacity pipeline operations try the stamina of pumping engines. And, Allis-Chalmers engines are truly engineered to the job. They are ruggedly built with precision bearings and husky, accurately balanced parts throughout. Preventive maintenance is convenient. Overhaul, after thousands of hours, is simple and economical in both parts and labor. And you can be sure high performance will be restored.

You, too, can have power for profit and dependability with Allis-Chalmers engines. They're available in sizes up to 516 hp. There is one suited to every oil field job. Call your Allis-Chalmers dealer or write for specifications and details. Allis-Chalmers, Milwaukee 1, Wisconsin.



These five Allis-Chalmers PC-1879 engines are pumping crude to a main line. They've been in continuous service for up to seven years in a California oil field.

Here, three Allis-Chalmers 8PC2505's are pumping in West Texas. Satisfaction with two of these engines in service for several years made the choice of a third engine simple.



These Allis-Chalmers engines --five 2505's and two 1335's—pump a million and a half barrels per month. They're in continuous service in the West Texas fields.

ALLIS-CHALMERS

***POWER* FOR A GROWING WORLD**

BD-9

"USING FORD HEAVIES HAS MADE A BIG CUT IN OUR MAINTENANCE COSTS"

says Allen Grosse
Fleet Supervisor
Green Bay Box Company

Handling heavy loads with ease, this Ford C-1000 used by the Green Bay Paper and Pulp Company (an affiliate of the Green Bay Box Co.) grosses 60,000 lb. It is equipped with 260-hp 477-cu. in. Super Duty V-8, Extra Heavy Duty 5-Speed transmission and 6.50 to 1 rear axle ratio.

GO FORD-WARD for Savings, Style and Stamina!

Whatever your job . . . wherever you do it—you'll find Ford Heavies and Extra Heavies are engineered and built to do it better! And the '59 improvements in these models will bring still more benefits to your operation.

Greater operating economy with new, faster rear axle ratios and wide choice of transmissions.

More efficient parking brake of the internal expanding type has approximately 50% greater stopping and holding ability, requires less than half the operating effort needed for the previously used type.

Higher payloads and longer life with new, higher-capacity front and rear axle options.

Factory installed tractor package custom-fitted to Ford trucks for safer, more dependable braking.

Yes, the new '59 Ford trucks are here to take you *Ford*-ward for savings, *Ford*-ward for modern style and stamina. See your Ford Dealer today!

"Our records show that our average monthly parts cost, including major overhauls, has been reduced over 24%.

"Our Fords have given us less trouble than any other make of truck we've owned! Also, our Ford Dealer has always given us immediate and very good service. We've never had any downtime waiting for parts. They're always available at our Ford Dealer's, so we don't have the problem or expense of carrying a big parts inventory.

"Our drivers sure like the 'hillability' of the big Ford Tilts with their Super Duty V-8 engines! They say the 'Big V' has sure got it for power that seems to level out the steepest hills. And the Tilt Cabs are tops for maneuverability and riding ease.

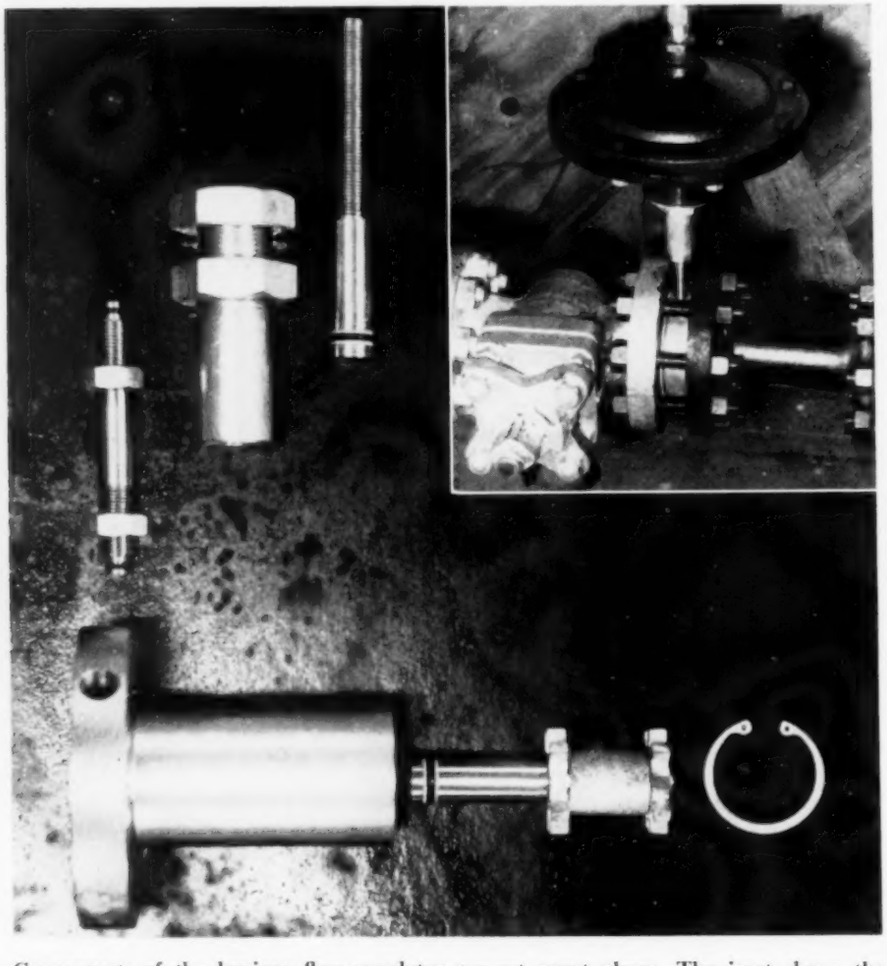
"Performance plus economy . . . that's why we're sold on Ford trucks. We started using Fords when we opened our trucking department in 1954, and today 28 of our 35 trucks are Fords."

New Styleside pickups! Notice the handsome new grille, dual headlights, stronger wrap-around bumper. 6½-, 8- and 9-ft. boxes available in Styleside or Flareside models. Short Stroke Six or V-8 engines.

FORD TRUCKS COST LESS

LESS TO OWN . . . LESS TO RUN . . . LAST LONGER, TOO!

What's New in EQUIPMENT



Components of the laminar flow regulator are set apart above. The inset shows the regulator as it is in operation.

Laminar Flow Regulator

Welker Engineering Company announces a new type flow regulator for gas and liquid pipe lines and process service. The regulator utilizes conventional controls and diaphragm motor. The diaphragm plate is connected to a master hydraulic piston which operates a slave piston within the regulator body. Flow through the regulator is controlled by compression of a solid Hycar rubber plug by the slave piston acting against a movable slotted baffle. The entire control assembly consists of the slave piston, movable baffle, rubber plug and fixed baffle; all of it is held in lateral position by a Truarc ring.

Flow is controlled by increasing or decreasing the annular area between the rubber plug and interior regulator body. Fluid flow is laminar through the regulator and may be regulated in infinite steps from full flow to bubble tight shutoff. Laminar flow eliminates jetting of high speed gas and transient particles into the side of the regulator which is often a source of failure in conventional regulators. Construction and material used in the regulator conform to ASA and ASTM specifications. Flange on the regulator has the same O.D. as the raised face on flanges it fits between and can be put into service with no special fittings. Maintenance is simple, as the regulator can be dismantled as one unit.

The regulator can be used for controlling back pressure, controlling down stream pressure, flow control, dump valves and manually operated valves. It is available in sizes from 1 inch to 4 inches including three models in each size—insert, flanged, screwed. Regulators have steel bodies and chrome lined hydraulic cylinders; for special applications alloy steels may by ordered.

For more data, circle **No. E1** on Readers' Service Card, last page this issue.

Test Resistance Networks

Addition of synchro and resolver test resistance networks to its line of high precision measuring devices is announced by Rubicon Instruments Division of Minneapolis-Honeywell Regulator Company.

The networks are designed for convenient testing of synchros and resolvers to determine electrical error by the proportional voltage method. Both are available with steps of 2½, 5, or 15 degrees. Voltage dividers permit full 360 degree rotation to be checked without changing connections.

For more data, circle **No. E2** on Readers' Service Card, last page this issue.

Microwave Package

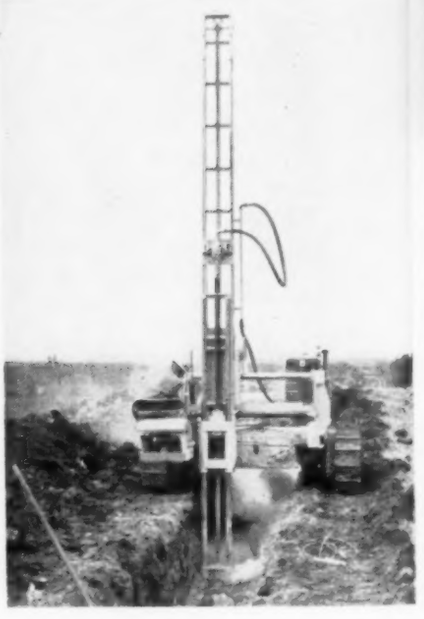
A new weather-enclosed microwave package has been designed by General Electric Company to extend the life and reliability of communications systems where difficult atmosphere conditions exist.

The package includes an air-conditioned housing with zinc-coated steel panels, sealed with neoprene. Although light enough to be airlifted from one site to another, it is constructed to stand high velocities.

The enclosure portion of the system is 102 inches high, 72 inches wide and 30 inches deep. With relative humidity up to 100 percent recorded the microwave package reduces inside humidity 60 percent. Where ambient temperature outside varies from 25 to 100° F. inside temperature remains 75° F.

(This item supplements General Electric Company data on Pages 181-188 of the Pipe Line Composite Catalog, 1st Edition.)

For more data, circle **No. E3** on Readers' Service Card, last page this issue.

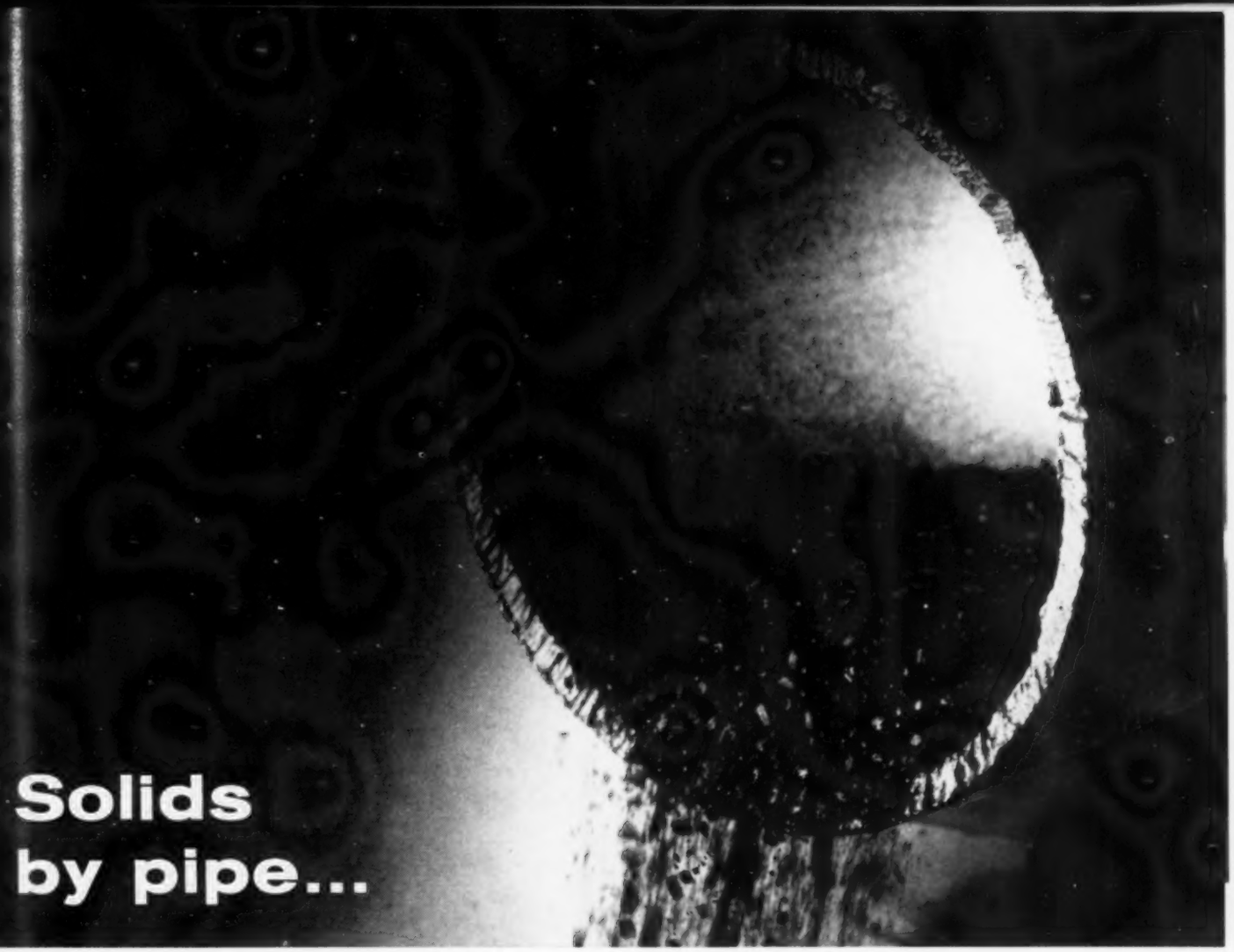


Rotary Drill Unit

Pipe line Blastholer, a self-propelled rotary drill unit for blast holes up to 9 feet deep, has been introduced by Drilling Accessory & Manufacturing Company, Inc.

Only one operator is required and all controls are centrally located at the driver's position. The compact unit is mobile and travels all types of terrain. The Blastholer is 8 feet, 6 inches in width, 15 feet in length with a height of 19 feet, 7 inches. The heavy-duty steel frame is mounted on track. It has been field tested drilling holes in various types of rock.

For more data, circle **No. E4** on Readers' Service Card, last page this issue.



Can you meet the challenge of this new day in bulk transportation?

Will you be in the running when the pipeline industry's biggest new job starts taking shape?

Solids by pipeline is no longer a dream. It's a highly successful reality.

Gilsonite . . . coal . . . *what raw material will be next* to start moving to market through a pipe?

As you get set to meet the mighty challenge and opportunity that solids pipelining presents to your industry, remember this:

1. Men who engineer solids pipeline systems find that *uniform concentration* of solids is a must in a pipelined slurry.
2. You can get the slurry uniformity you want—with LIGHTNIN Mixers.

LIGHTNIN Side Entering Mixers keep 700 tons of solids per day uniformly suspended for dispatch through the pioneer American Gilsonite Co. pipeline. LIGHTNINS in thousands of chemical plants mix slurries of every kind, rapidly, dependably—*to the exact level of uniformity needed.* If it can be slurried, you can slurry it *uniformly* with LIGHTNINS.

If you'd like quick, competent help on slurry suspension for a specific project, call in your LIGHTNIN Mixer representative now. He's listed in Pipeline Composite Catalog. Or write us in confidence.

Good mixing helps move Gilsonite over a mountain

Solids pipeline built by American Gilsonite Co. makes the refining of gasoline from Gilsonite economically possible. It saves more than $4 per ton—a million dollars a year—over other methods of transporting Gilsonite ore over a mountain from mine to refinery.

American Gilsonite's 6-inch pipeline carries slurries averaging 38% solids and 62% water at 350 gallons per minute. It delivers more than 700 tons of solids per day at the downstream end, 80 miles from the eastern Utah mine.

Cut from the solid vein with high-pressure jets of water, the shattered ore is flumed more than a mile underground to the bottom of the 800-foot-deep central shaft.

Then the ore is screened to 8-mesh maximum, pumped to the surface with fluming water, and mixed to uniformity in 200,000-gallon holding tanks equipped with LIGHTNIN Side Entering Mixers.

Lightnin® Mixers MIXCO fluid mixing specialists

MIXING EQUIPMENT Co., Inc., 196-m Mt. Read Blvd., Rochester 3, N. Y.

In Canada: Greey Mixing Equipment, Ltd., 100 Miranda Ave., Toronto 19, Ont.

Commercial Fittings

W-S Fittings Works has announced the addition of commercial fittings to the "Double Diamond" line of products. The fittings include bushings, caps and plugs.

Fittings are not intended for severe code applications, but are suitable for 300 pound steam at 555° F. They feature high quality threads, alignment and concentricity. For more data, circle **No. E5** on Readers' Service Card, last page this issue.

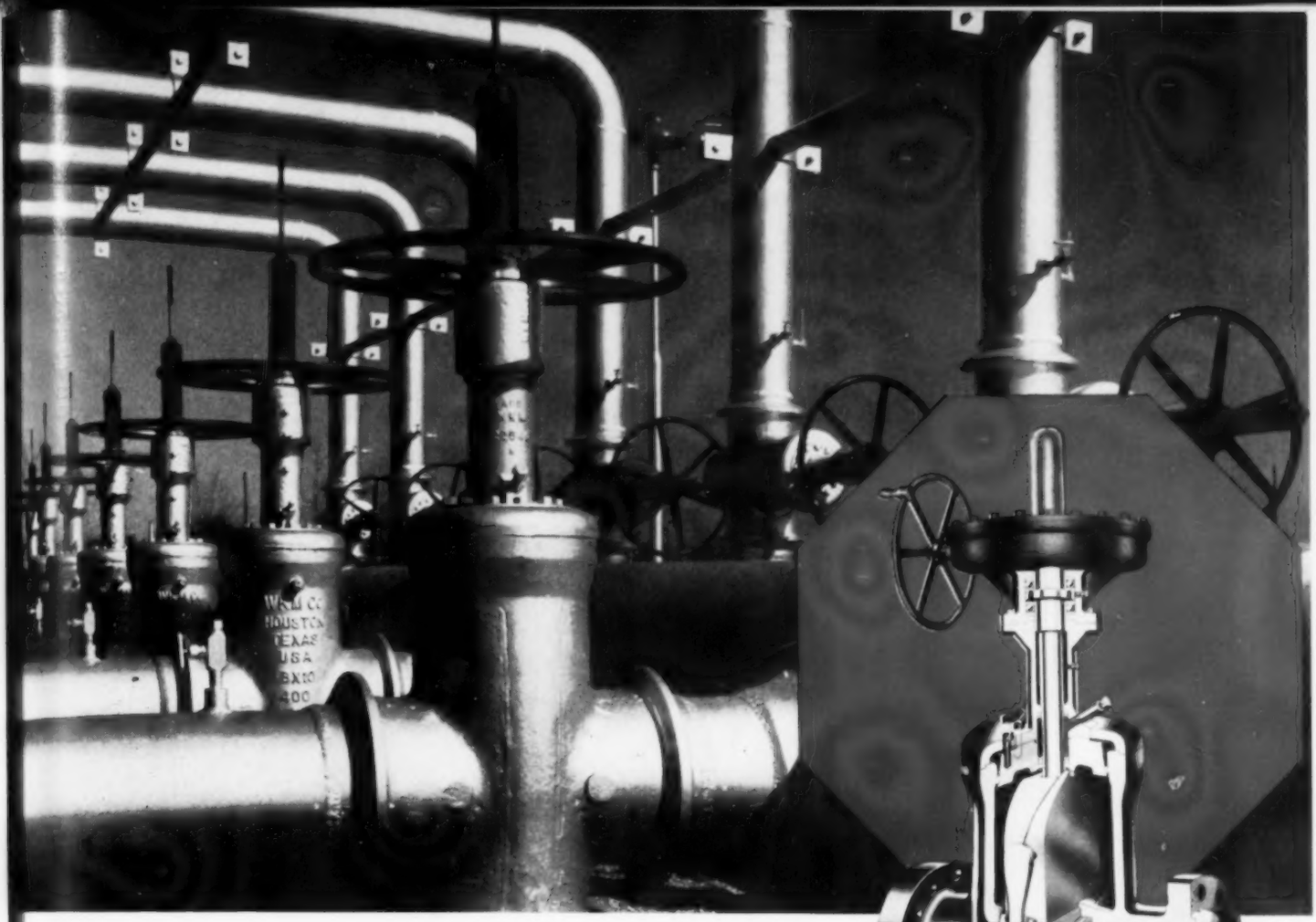
Lube Alert System

A protective device for use on force-feed lubricating systems is announced by Manzel, division of Houdaille Industries, Inc.

The "Lube-line alert" is installed at each terminal point of lubrication by simply cutting the line and connecting the fittings. It is connected electrically to any desired audio, visual or mechanical warning unit; if the flow of lubricant through the unit is interrupted for any reason, the signalling system is activated. The alert device is usable with any viscosity oil or synthetic lubricant, and for pressures up to 10,000 psi. Explosion-proof units are available for use where conditions require them.

For more data, circle **No. E6** on Readers' Service Card, last page this issue.

PROVED BY MILES & MILES & MILES &



W-K-M's *Creative Engineering* gives pipeliners the answers to their valve problems

TYPICAL!

W-K-M's creative engineering process begins with your problems: design, production and field service are based on your needs. That's why W-K-M's ASA Gate Valves set the standards on pipelines throughout the world.

No other valve can give you tight seal upstream and downstream, *plus* the positive control of gate and segment afforded by W-K-M's exclusive gate centralizer.

No other valve gives you the same economical maintenance, the same long life combined with "on-the-line" overhaul.

For complete dependability and long-range economy, specify W-K-M ASA Gate Valves—they're the answer to all your pipeline valve problems.

This W-K-M ASA Gate Valve is typical of W-K-M's superior design, painstaking production, and thorough testing.

Features include: Through-conduit; pressure seal bonnet; parallel expanding gates; exclusive gate-centralizing mechanism; enclosed packing box; super-finished stem; seat lubrication.

Design assures: freedom from destructive turbulence . . . no surge operation . . . free passage for pigs or scrapers . . . on-the-line overhaul.

WRITE FOR CATALOG 300

W-K-M

DIVISION OF ACF INDUSTRIES
INCORPORATED
P. O. BOX 2117, HOUSTON, TEXAS

5609

Check Valve

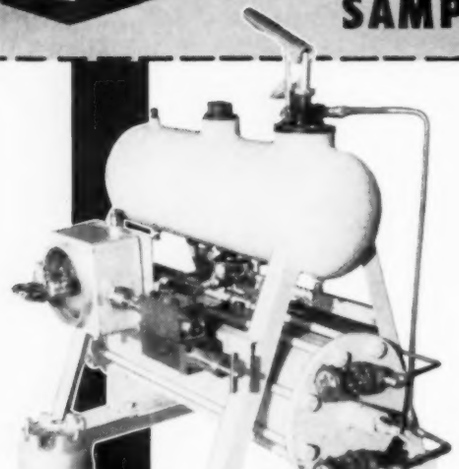
A top entry, double union check valve, insulated against electrolytic action, has been designed by Clayton Mark & Company. Featured with a precision manufactured bronze clapper it is engineered to provide quiet operation and effective closure when the flow pressure drops.

Quick removal and replacement of parts is possible through the valve's top entry. The treaded top entry cap is made for fast opening and pressure resistant closure.

Insulation against uncontrolled electric currents is available in one union end. This feature prevents expensive damage from galvanic action to pipes and equipment in the flow system.

For more data, circle **No. E8** on Readers' Service Card, last page this issue.

MECO **PROPORTIONAL PIPE LINE SAMPLER**



Withdraws composite sample of pipe line fluid at rate proportional to pipeline flow.
- Sample stored at pipeline pressure.
- Variations in line pressure have no effect on operation.
- Wide flexibility — 5 samples per bbl. to 1 sample per 42 bbls.
- Paced by Positive Displacement Liquid Meter.
- Sampler furnished completely assembled and mounted on sturdy base.

MECO Pipe line Sampler consists of a Pilot Type transmitter mounted on and paced by a positive displacement meter.
- An adjustable proportioning slide valve — operates in clean oil.
- Sample cylinder (single or dual) with piston position indicating rod.
- A clean oil reservoir.

Pipe line sampler available to 600 psig operating pressure.

for perfect **PIPE LINE SAMPLES**

specify **MECO** PIPE LINE SAMPLER

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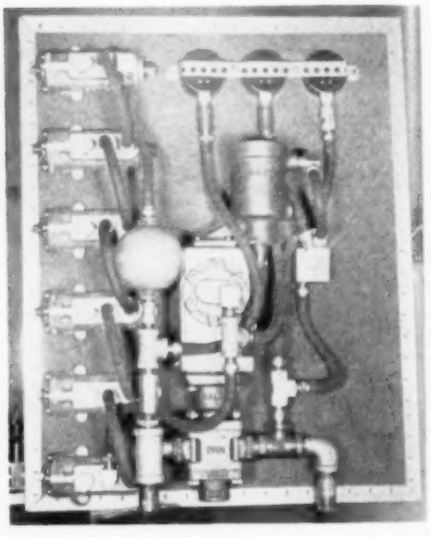
3751 CLINTON DRIVE — HOUSTON 20, TEXAS



Indicating Relay

Amot Controls Corporation announces Model 2400 indicating relay used in determining which safety control component caused the engine to shut down. One relay is used for each safety control component. When engine starts, each relay resets itself and its window shows green. If a dangerous condition occurs, such as low oil pressure, the low oil pressure component in the safety control system will vent causing the corresponding relay to show red. After shutdown, all windows will show green except the one that caused the shutdown.

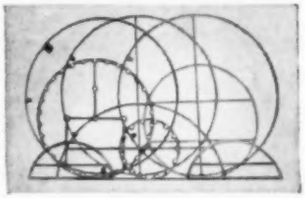
Electric power is not needed for the mechanical indicating system. Either gas pressure or air pressure is used. This system offers advantages in gas compressor stations requiring explosion-proof electrical systems, stations in which electricity is not available, and in jobs which require a simple mechanical system in which expert electricians are not required to make repairs.

For more data, circle **No. E9** on Readers' Service Card, last page this issue.

Portable Calibrator

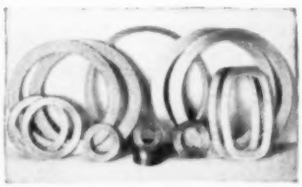
Taylor Instrument Companies announces a portable test set for checking and calibrating amplifiers and process controllers. The Taylortest 1 is a combined precision signal source, potentiometer and milliammeter. The self contained instrument provides all facilities, accuracy and convenience requisite to testing in the field or laboratory. The unit has two millivolt ranges, 0-60 absolute MV, and 95 MV up to 105 MV. It is useful for measuring the outputs of thermocouples, thermal co-

GASKETS
For Every Purpose



HEAT EXCHANGER GASKETS

Made in any size or shape needed in double jacket type. Also cut from solid metal or sheet packing. Write for Bulletin 564.



CORRUGATED METAL GASKETS

Plain or jacketed type. Made of ingot iron, aluminum, stainless steel, copper, brass, nickel and monel in all sizes and shapes. Write for Bulletin 565.

PROMPT DELIVERIES

CHICAGO-WILCOX MFG. CO.

7705 So. Avalon Ave., Chicago 19, Ill.

SOMERVILLE
tackles a
tough job in Montreal

The British Petroleum Co. needs 8 pipelines to connect their refinery with dock loading facilities on the St. Lawrence. It's a long three miles through rock and stone and a tough job that has been kept on schedule thanks to Somerville know-how and experience.

SOMERVILLE
CONSTRUCTION CO.
Ada, Michigan
SIGN OF TRANSMISSION LINES
SATISFACTION DISTRIBUTION SYSTEMS

Undisputed Champion!

Allan Edwards

HEAVYWEIGHT

RIVERWEIGHTS

PUT YOUR

PIPELINE

. . . DOWN FOR KEEPS

Allan Edwards, Inc., is the nation's oldest manufacturer of concrete river-weights. Weights are carefully designed and constructed to meet individual requirements. Weights can be constructed at your jobsite if tonnage warrants. Other fine Allan Edwards pipeline specialty products include . . .

WELDING SLEEVES • HALF SOLES • MARKER POSTS

Allan Edwards, Inc.
2445 S. Jackson—P. O. Box 7218, Tulsa, Oklahoma

More comments on this new Handbook:

". . . a most practical on-the-job manual for men concerned with pipe line corrosion. We are ordering copies for each of our district engineers."

Pipe Line Corrosion and Cathodic Protection

By MARSHALL E. PARKER

This Handbook, written by Marshall E. Parker, consultant, is designed as a practical field manual. It is a 108-page pocket-size volume printed first as a popular series in WORLD OIL. The Handbook is illustrated with many charts and drawings and is completely indexed by subjects.

It presents comprehensive data on Soil Resistivity Surveys, Potential Surveys, Line Currents, Current Requirements, Rectifier Systems, Ground Bed Design, Magnesium Anodes, Stray Current Electrolysis, Interference in Protective Systems, Operations and Maintenance, and Coating Protection and Testing.

An appendix has been added of technical data on Underground Corrosion, Basic Principles of Cathodic Protection, Properties of Metals and Attenuation Equations. Order copies of this practical Field Manual now for each of your field men. Price $3.

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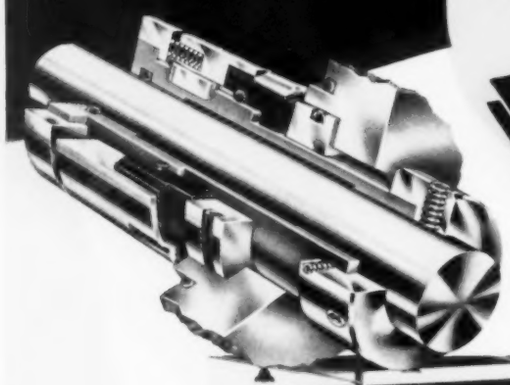
. . . and ANOTHER Pipe Line Company CONVERTS TO John Crane® 8-B SEALS



A COMPETITIVE FIELD TEST in which one half the pumps were equipped with JOHN CRANE 8-B Seals and the other half with various competitive seals was recently conducted by a leading pipe line company.

THE RESULT showed that in *every* case the JOHN CRANE 8-B Seals out-performed all other seals in the system both in positive sealing and length of service.

PROOF AGAIN that wherever service is tough and pressures are high, 8-B Seals successfully do the job.

JOHN CRANE 8-B Seals are easily installed and will handle all pressures encountered in modern pipe lines. They are available in a full range of shaft sizes for every main line or tank farm pump service.

Request Bulletin S-215-1. Give mechanical and service details for specific recommendations.

•

Crane Packing Company, 6434 Oakton Street, Morton Grove, Illinois (Chicago Suburb)

In Canada: Crane Packing Company, Ltd., Hamilton, Ont.

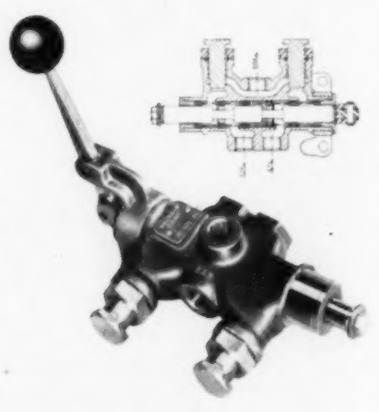
CRANE PACKING COMPANY

verters, radiation receivers, shunts and other primary measuring elements.

A "signal-measure" switch is provided so that it may be used as a source of known millivolt signals. For checking amplifier output currents, the instrument is equipped with an indicating meter. The meter is scaled from 0 to 5.0 milliamperes, direct current. For ordinary testing and calibrating the direct meter indications are useful. Where greatest precision is required, an individual correction card is furnished with each meter, permitting corrections on test data to a high accuracy level.

(This item supplements Taylor Instrument Companies data on Page 376 of the Pipe Line Composite Catalog, 1st Edition.)

For more data, circle **No. E10** on Readers' Service Card, last page this issue.



Four-Way Valve

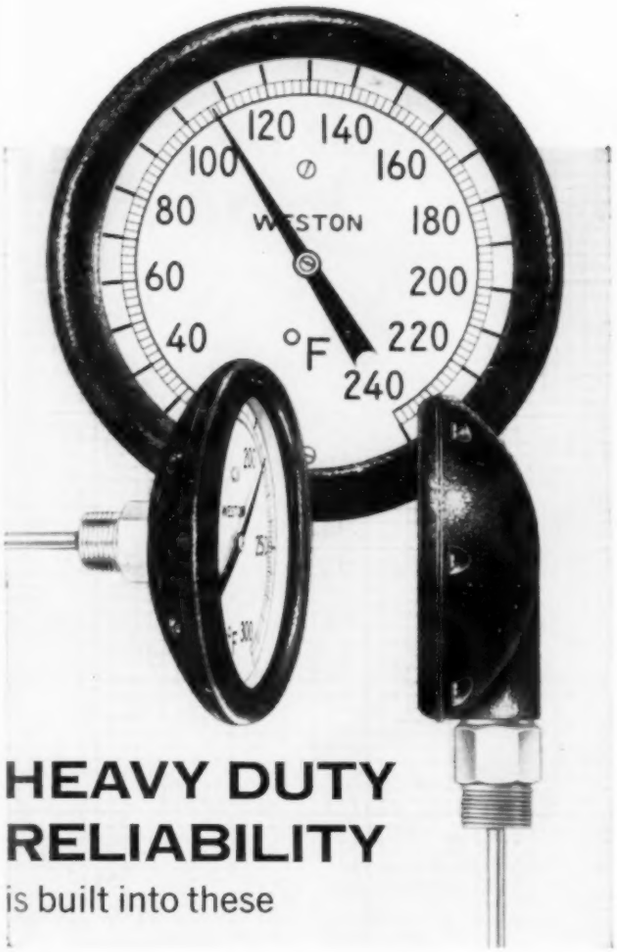
Valvair Corporation announces a manually operated four-way valve, with built-in speed control.

Designed to afford precise operating speed regulation of double acting cylinders and similar devices the new valve is offered with ¼ or ⅜-inch NPT ports.

The valve is offered as a standard lever operated type; as a spring-centered neutral type; double acting, cylinder actuated, spring-centered neutral type; or with any desired applicable combination. For pneumatic service, valves are fitted with molded Hycar "OU" packers. O-ring packers are employed in valves for hydraulic or vacuum use.

For more data, circle **No. E11** on Readers' Service Card, last page this issue.

WESTON THERMOMETERS: STANDARDS OF STABILITY IN SCIENCE AND INDUSTRY



HEAVY DUTY RELIABILITY

is built into these

WESTON BIMETALS

For lasting accuracy, even under punishing conditions, you can depend on Weston heavy duty bimetal thermometers. Exceptionally stable sensitive elements . . . corrosion-proof, pressure-tested stainless steel stems and connection nuts . . . rugged forged brass heads . . . suit these bimetals for the most strenuous service. Accuracy is assured within 1% of full scale range. 20 standard ranges: running from −100° to 1000°F or −100° to 400°C. Standard stem lengths from 2½" to 72".

Model 2221: has a 5" diameter head with 9" scale.

Model 2231: 6" diameter head with 12" scale.

Model 1221: straight form—basically the same as Model 2221, but with scale parallel to stem. Stem can be located in any one of 24 positions around the periphery of the head.

For full information, call your local Weston representative, or write to Weston Instruments, Division of Daystrom, Inc., Newark 12, N. J. *In Canada: Daystrom Ltd., 840 Caledonia Rd., Toronto 10, Ont. Export: Daystrom Int'l., 100 Empire St., Newark 12, N. J.*

WESTON

A DAYSTROM UNIT

Instruments

As SIMPLE and Dependable as the Pull of a MAGNET!

A sleeve, raised and lowered within a non-magnetic tube, attracts or releases an Alnico magnet attached to a mercury switch. Basically, this is Magnetrol.

MAGNETROL

The Simplest, Most Versatile LIQUID LEVEL CONTROL Ever Devised!

Linked to liquid level by infallible magnetic force, Magnetrol is free from the limitations inherent in mechanical or electrical controls. With the actuating magnet rated at 98% of initial strength after 30 years, Magnetrol has *infinite operating life,* with practically no maintenance at all. There are no wearing parts to get out of order.

What's more, Magnetrol's simple operating principle permits easy, economical modification of standard units to meet *any* pressure, temperature or corrosion requirements. That's why there's practically no limit to Magnetrol's use. It's also why "specials" are likely to be standard with us. Magnetrol units control level changes from .0025-in. to 150-ft. —with single or multi-stage switching.

MAGNETROL, Inc.

● SEND COUPON FOR DETAILS ▶

MAGNETROL, Inc. 2128 S. Marshall Blvd., Chicago 23, Illinois
Please send me catalog data and full information on Magnetrol Liquid Level Controls.

Name _____

Company _____

Address _____

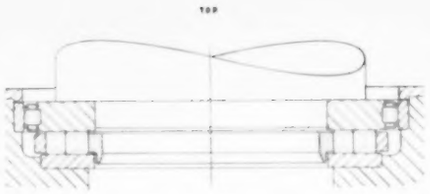
Zone _____ State _____

Pulse Code Meter System

Vapor Recovery System announces a pulse code positive displacement meter telemetering system. The receiver displays meter readings in digital form to six places or 999,999 units. Two remaining spaces of the eight section horizontal read out window indicates the numerical identification of the meter being contacted. Reading cycle is completed in seven seconds with selection of the meter by telephone.

Transmitters are furnished in explosion proof enclosures; the imput may be either electrical (pulse or contact) or mechanical (direct drive).

For more data, circle **No. E12** on Readers' Service Card, last page this issue.

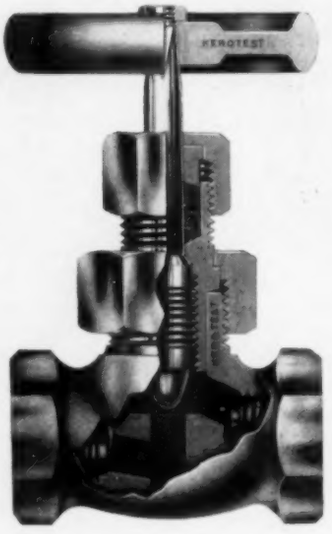


Cylindrical Roller Bearings

Rollway Bearing Company announces its dual-duty cylindrical roller bearings designed for application where both thrust and radial loads must be carried in a restricted space. The unit consists of two roller assemblies—radial and thrust—with the flanged inner race of the radial section serving at the same time as the revolving plate of the thrust section. The outer race of the radial bearing is stationary with respect to inner race, and is completely separable to facilitate assembly in restricted space.

Bearing capacity, size and design can be altered to meet customer specifications.

For more data, circle **No. E13** on Readers' Service Card, last page this issue.



Needle Valve

Kerotest Manufacturing Company announces its N-20 globe type needle valve designed for high pressure service in pipe lines, industry and petrochemical services.

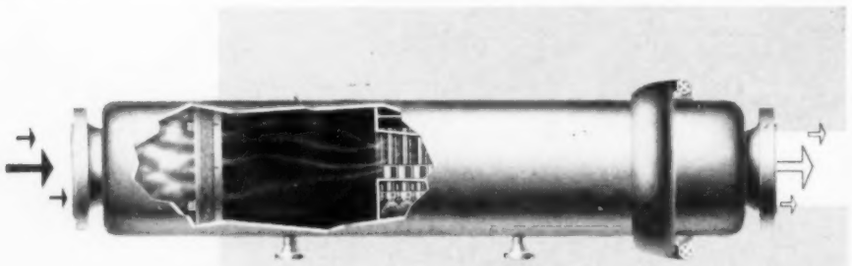
The valve can be used for throttling, regulating or shut-off. It features a newly designed forged carbon steel body, backseating construction which permits repacking under pressure, and heat treated stainless steel stem operating in a sleeve yoke. Maximum working pressure is 10,000 psi at 70° F; maximum operating temperature, 750° F. Special packing can be furnished for higher temperature ratings.

For more data, circle **No. E14** on Readers' Service Card, last page this issue.

Transformer-Rectifier

Miller Electric Manufacturing Company, Inc., announces an A.C.-D.C. transformer-rectifier welder. The Miller "Twin" delivers two A.C. ranges, 20-115 and 60-180, and one D.C. range of 40-150 amps. This is adequate for nearly every job encountered in stations, garages and small industries.

For more data, circle **No. E15** on Readers' Service Card, last page this issue.



this NEW AEROTEC two-stage mist extractor:

1. **Knocks slugs of moisture out in the first stage**
2. **Collects agglomerates in cyclone second stage**
3. **Accomplishes efficient extraction at high velocities in a comparatively small unit**

A knitted mesh pad as the first stage of the Aerotec Mist Extractor removes slugs of water and agglomerates fine mist particles into drops that are removed by the second stage. This second section is composed of multiple small diameter cyclone tubes.

Since an increase in the efficiency of the cyclone tubes results from a velocity increase, it is possible to assure removal of the moisture in the gas at much higher velocities than would be possible through a conventional impingement type extractor. The higher velocity also requires a smaller unit for a given SCFD.

Aerotec has an enviable record in the development of gas scrubbers utilizing the dry centrifugal method of removing moisture and other impurities from the gas stream. These units will be found on practically every gas line in the U. S. and in many foreign countries. Contact our Project Engineers for further details on the new two-stage mist extractor.

AEROTEC

Project Engineers

THE THERMIX CORPORATION

Greenwich, Conn.

(Offices in 38 principal cities)

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THE AEROTEC CORPORATION

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Somastic® Coated Pipe is your permanent protection against corrosion

Central or railhead plants are available to you for the application of Somastic® Pipe Coating. It is *thick*. It is *seamless* . . . no holidays because of overlapping layers, or bubbles. It is *re-inforced*, permanently. It is *rigid yet elastic*. And . . . it is proven under adverse soil conditions for more than 25 years. Why not coat your pipe *the better way?*

Write for full information TODAY!

Specializing in Pipe Protection Problems
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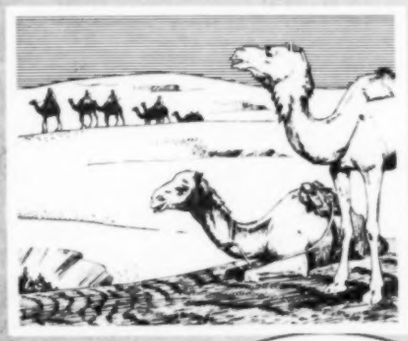

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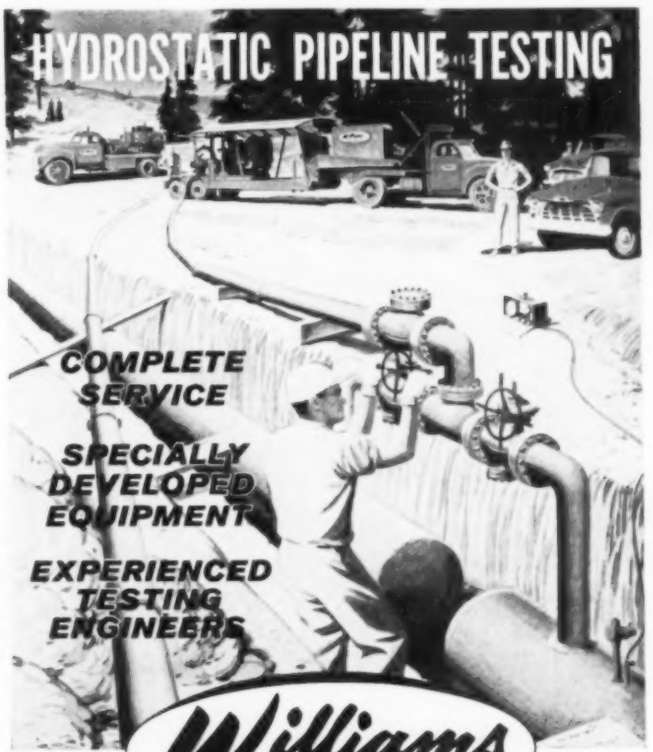

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EXPERIENCED TESTING ENGINEERS

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Call Shreveport 4-2678

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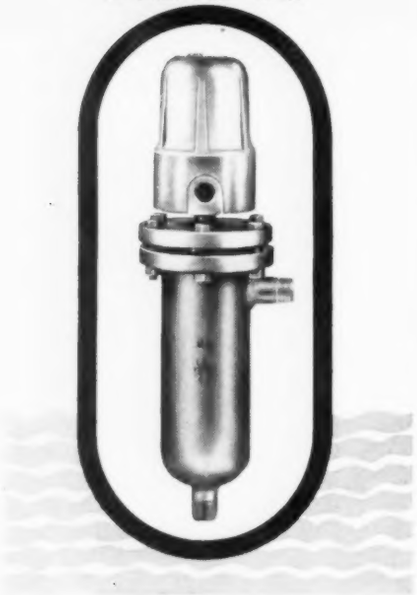

LEVEL MASTER®

The UNFAILING Liquid Level Control!

The ability to function with *continuous, sensitive control* with liquids is the standout feature of Level Master. The "brain" of Level Master is the unique Bell Magnetic Proximity switch incorporating a permanent Alnico V magnet that responds instantly to changes in liquid level!

- *Models for all types of liquids.*
- *Horizontal, vertical, external mountings.*
- *Precision engineered for long life operation.*

For full information consult your Level Master representative or write directly to:

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Phone GArden 5-0240

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5456 W. 111th St., Oak Lawn, Ill.

Send full information on Level Master and name of nearest representative.

My name_____

Company_____

Address_____

City_____ Zone____ State____

New Equipment Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader Service postcards just inside the back cover and facing the Advertisers Index. Simply circle code numbers of items desired—sign and mail card.

Pipe Line Sampling

Precise automatic methods of sampling directly from pipe lines are described in a new eight-page bulletin issued by Proportioners, Inc., a division of B-I-F Industries, Inc.

The booklet, illustrated with photographs and schematic drawings, describes technical aspects such as line stratification, flow profile, sample probe location and economic factors. Two basic methods—time proportional and flow proportional sampling—are explained and various devices for each are analyzed. The bulletin tells how savings can be realized by accurate sampling and provides a thorough understanding of all aspects of the sampling process.

To get a copy, circle **No. E16** on Readers' Service Card, last page this issue.

Full-Encirclement Saddle

Tube Turns Division of Chemetron Corporation announces a bulletin describing in detail the dimensional data, cyclic life and correct welding procedures for the "Full-Encirclement Saddle."

The full-encirclement saddle provides a full 360-degree reinforcement of the pipe and is split longitudinally. Included in the bulletin is a chart of relative life of branch connections, showing cyclic life of the full-encirclement saddle greater than ordinary saddles.

Important dimensional changes reported in the bulletin are expansion of size range to include full size outlets for sizes up to 24 inches, and "center to end" dimensions, which now equal the O.D. of the run pipe.

To get a copy, circle **No. E17** on Readers' Service Card, last page this issue.

Instrument Photoprints

The Bristol Company is making ¼-scale photoprints of its instrument line available to engineers, designers and other persons concerned with instrumentation layout.

The new cut-out and paste-on technique gives a clear, accurate picture of a proposed control panel which is handy during early planning stages. The reproductions are full-size, and miniature electronic and pneumatic control and recording instruments are offered.

To get a copy, circle **No. E18** on Readers' Service Card, last page this issue.

Filter Replacement

"Not An Element of Doubt," a new eight-page booklet released by Caterpillar Tractor Company, presents helpful service tips on filter replacement.

The two-color booklet contains cost study information coupled with recommendations for extending oil change periods. The inner parts of filter elements are illustrated with cutaway photographs. The importance of proper fit, temperature stability and rate of oil flow are also discussed. Booklets are available in English, French, Spanish and Portuguese.

To get a copy, circle **No. E19** on Readers' Service Card, last page this issue.

Propeloflo, Shuntflo Meters

Builders-Providence, Inc., announces a bulletin on the Propeloflo meter for liquids and the Shuntflo meter for air, steam or gases.

The six-page bulletin includes photographs, line drawings, cutaway views and technical data tables. The Propeloflo meter, available in sizes 2 inches and larger, measures flow by means of a propellor which rotates at a speed proportional to the flow rate and reads directly in gallons, cubic feet, barrels and other units. The Shuntflo is a turbine-actuated totalizing flow meter with deflected flow turning a rotor at speeds proportional to flow rate.

To get a copy, circle **No. E20** on Readers' Service Card, last page this issue.

Vapor Phase

Engineering Controls Inc. announces publication of an engineering manual on vapor phase engine cooling and waste heat recovery for internal combustion engines.

The catalog is highly illustrated with photographs and schematic drawings of various models of compressor stations. The manual includes sections on engineering data, sample specifications, specifications and schematics, sewage disposal plants and separate sections on compressor engines of several companies.

To get a copy, circle **No. E21** on Readers' Service Card, last page this issue.

Cleaning Pigs

General Descaling Company Limited announces a 10-page brochure entitled "Cleaning Pigs and Go-Devils." Illustrated with photographs and schematics, the brochure gives a complete rundown on its line of pigs and go-devils.

The two-color booklet include charts which give details of parts and general dimensions of the equipment.

To get a copy, circle **No. E22** on Readers' Service Card, last page this issue.

New Pistons

When pistons in large stationary diesel engines or gas compressor units need replacing . . .

buy Exline's Ni-Chrome Pistons

Write For Prices

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Salina, Kansas

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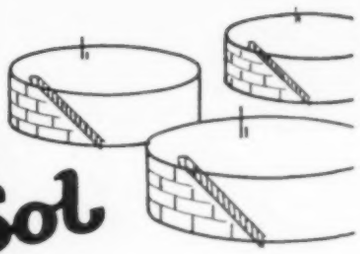
the most effective chemical for treating
PARAFFIN
The money you make on reclaimed tank bottoms by using BRAKESOL will be substantially more than the cost of treating . . . including chemical and labor. Safe for use in production, pipeline and refinery equipment . . . Contains no chlorides, sulphides or other halides.
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Kilgore, Texas....3210
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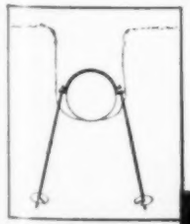
Here's the Fast Easy Way to Anchor Pipelines

No heavy equipment to haul. Cuts costs to a fraction.
Chance Pipe Line Screw Anchors and Brackets greatly simplify pipe line anchoring, compared to other methods, and save many dollars in pipe line construction.
Chance Pipe Line Screw Anchors can be installed in pipe line ditches without extra digging. Using a power wrench the operator merely guides the anchor in place. The tool does the work

Can be installed in the ditch without extra digging.
Write for catalog showing oil industry applications of Chance Earth Anchors.

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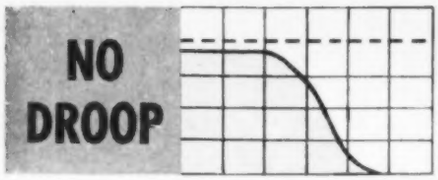

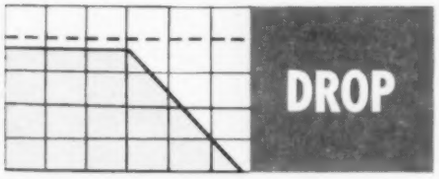

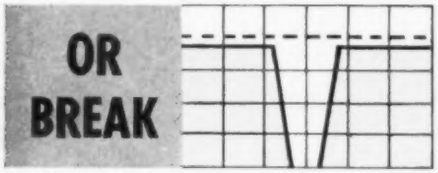

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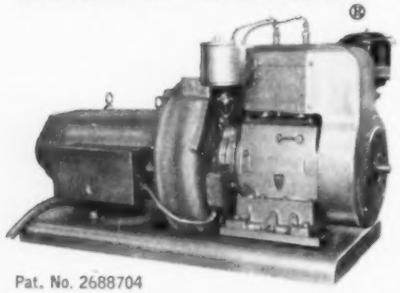

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Stable Continuous Uninterrupted

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Micro-Power operates *with* the main source of power. No time consuming "load transfers." No "power outages" *even for precious seconds!*

Micro-Power Units are available in 1500, 3000, 5000 and 10000 watt capacities. For complete information, specifications, and demonstration, write . . .

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• Whitmor Homebuilders Inc. 93
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Williams Brothers 107b
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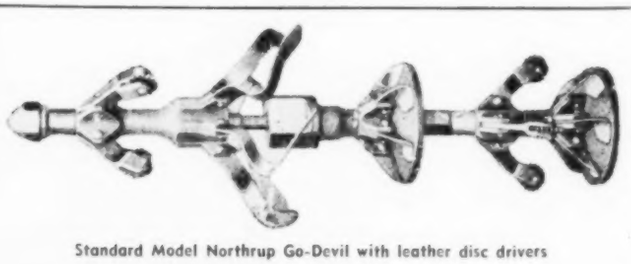
T. D. Williamson, Inc. 24
Wisconsin Motor Corp. 84

Y

The Youngstown Sheet & Tube Co. 68-69

Go-Devil



Standard Model Northrup Go-Devil with leather disc drivers

G. A. COTTEN CO.

Manufacturer of

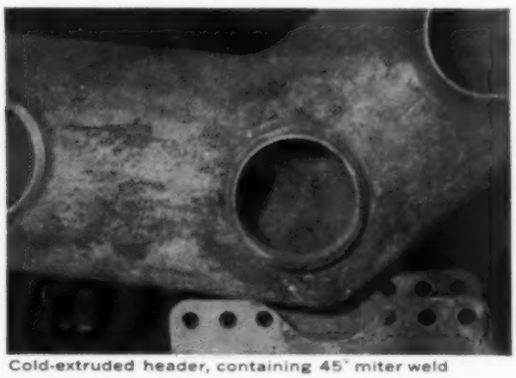
NORTHRUP GO-DEVILS & TRANSIT PIPE LINE SCRAPERS

P. O. Box 5332 — Tulsa, Okla.

Better, Stronger Piping Assemblies

through new Fluor cold-extruded prefabrication

Alloy steel header, with cold-extruded nozzles



Cold-extruded header, containing 45° miter weld

16-in. outlet nozzle, extruded in 30-in. diameter dampener head

Simple, more accurate fit-up... smoother nozzle contours... elimination of reinforcing pads assure important savings

WHEN YOU specify a multiple outlet header, cold-extruded by the new Fluor technique, you obtain a prefabricated piping assembly that offers higher strength, closer dimensional tolerance, smoother surface and greater uniformity.

Note these advantages Fluor-forming provides:

BETTER CONSTRUCTION: Fewer and simpler welds. More effective X-ray inspection.

LOWER MATERIAL COST: Elimination of reinforcing pads, saddles and collars makes savings in material costs substantial, especially where alloy steels are used.

SIMPLIFIED DESIGN: Nozzles or branches can be located anywhere along or around the header pipe.

SMOOTH NOZZLE CONTOURS: Minimizing pressure drop, reducing turbulence and erosion.

FASTER PRODUCTION: Less welding, less inspection make possible faster production and quicker delivery.

IMPROVED FIT-UP: Because of uniformly closer dimensional tolerances for each outlet nozzle, fit-up to adjoining piping is simple, accurate.

SAFETY: Uniform wall thickness, even distribution of mechanical stresses, avoidance of reinforcing pads and heavy welds assure protection against failure.

Write for Bulletin CE-0.001. EXTRUSION SALES, Fluor Products Company, Paola, Kansas.

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Generally called America's most modern steel plant . . Lone Star is primarily dedicated to supplying Joe Roughneck's API casing, tubing and line pipe needs.

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